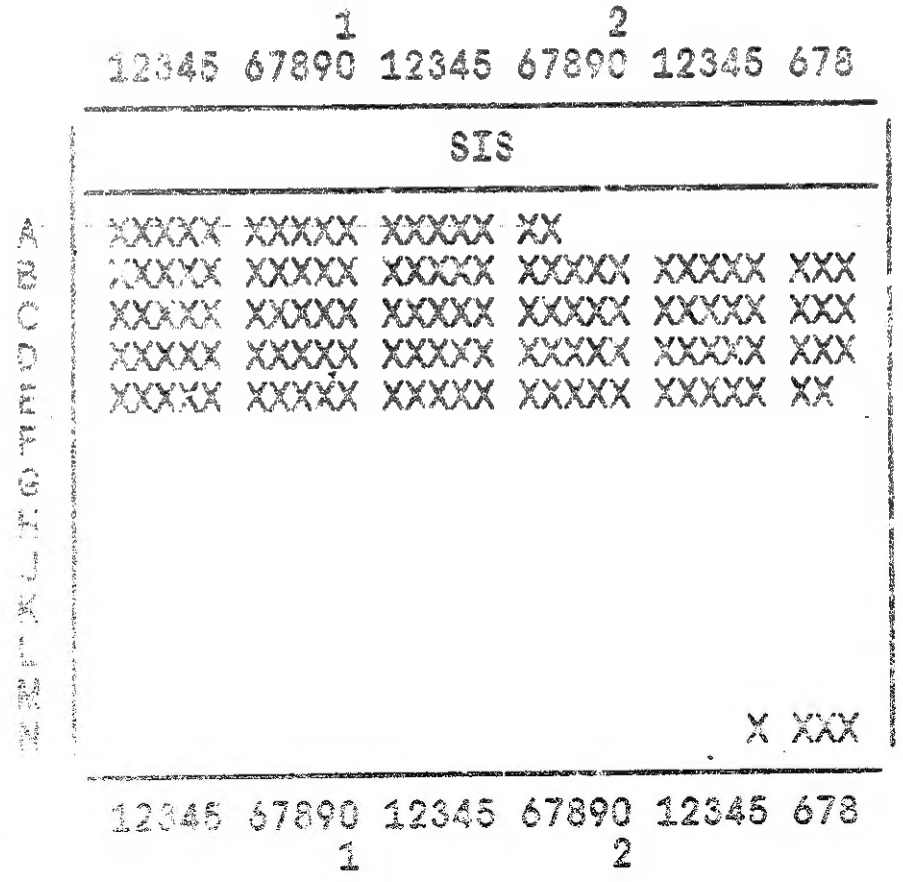
STRUCTURE OF MICROCARD

A01/1 = Structure of microcard
A03/1 = General instructions, test instructions, test specifications, safety precautions, tightening torques, tools and devices, calibrating oil, maintenance instructions
C01/1 = Disassembly, cleaning, visual inspection and assembly of nozzle-and-holder assemblies
E01/1 = Testing
N24/1 = Index
N26/1 = Table of contents
N28/1 = Editorial note

Continue: A02/1 Fig.: A01/2



Continue: A02/1

STRUCTURE OF MICROCARD

The user prompting appears on every page, e.g.:
– Continue: B17/1
– Continue: B18/1 Fig.: B17/2

.../1 = Upper coordinate half
.../2 = Lower coordinate half

Continue: A03/1

1. GENERAL INSTRUCTIONS

Nozzle-holder assembly and nozzle are high-precision products.
Maximum cleanliness is therefore to be ensured whenever work is being performed and at the corresponding workplace.
If contaminated, the calibrating oil as per ISO 4113 is to be replaced with new calibrating oil.
In doing so, the filter element of the nozzle tester is likewise to be renewed.
After pouring in the new calibrating oil, flush the interior of the unit by operating the hand lever.
When doing so, spray into open air without attachment of nozzle-and-holder assembly.

Continue: A03/2

GENERAL INSTRUCTIONS
The pressure gauge is to be checked once a month with a more precise reference gauge!

Please note that exclusive use is to be made of the plunger-and-barrel assemblies, delivery-valve assemblies and test-pressure lines indicated in the nozzle-tester service-parts list, since other parts result in different test prerequisites.

As opposed to the standard nozzle tester (EFEP 60 H), the nozzle tester 0 684 200 704 (EPS 100) has the following unique special features:

Continue: A04/1

GENERAL INSTRUCTIONS

Specification as per ISO 8984-1

Defined pollutant volume - correctable

Defined delivery rate

Pressure gauge of quality class 0.6

Reduced leakage rate

Fixed checking and maintenance intervals

Continue: A04/2

1.1 Notes on chatter and spray test

A distinction is to be made between new and used nozzles on nozzle assessment. Do not perform chatter and spray test simultaneously! Switch off pressure gauge of nozzle tester by closing shutoff valve. This is done to protect the pressure gauge.

New nozzles:
The chatter test makes it possible to audibly check the freedom of movement of the nozzle needle in the nozzle body.

Continue: A05/1

Notes on chatter and spray test

The chatter of new nozzles is a function of the following nozzle dimensions:

Seat, guide and blind hole/grinding diameter at end of needle.
This results in the formation of chatter characteristic groups which reflect the chatter behavior of the nozzles.
If the nozzle does not chatter despite cleaning, it is to be replaced with a new one. The shape of the spray if of no significance for the chatter test.

Continue A05/2

Notes on chatter and spray test

A spray pattern corresponding to the specification is generally only found with new nozzles.

Continue: A06/1

Notes on chatter and spray test

Used nozzles:

The chatter behavior of a nozzle is impaired by wear in the seat area. For this reason, the chatter characteristic groups are not to be used here.

When the lever is operated rapidly, the nozzle must be heard to chatter and/or provide a well-atomized spray.

The spray pattern of used nozzles may deviate from that of the ideal shape with a new nozzle. This does not, however, always make it possible to conclude that the engine running behavior will be impaired.

Continue: A06/2

Notes on chatter and spray test

The spray pattern of such nozzles can however be appreciably improved by way of suitable cleaning methods.

Continue: A07/1

1.2 Test instructions and specifications for opening pressure

The opening pressure prescribed for a nozzle-and-holder assembly is often marked in the nozzle-holder body.

If this is not the case, the value must be determined from the corresponding engine-manufacturer's documentation or from the equipment microcard (AK).

The adjustment tolerance is generally + 8 bar.

Continue: A07/2

Test instructions and specifications for opening pressure

The following values apply to the GMPT (GMC/Chevrolet) nozzle-and-holder assemblies 0-432-217-031,
0 432 217 092 and
0 432 217 104

New setting:	125 + 10 bar
Check :	min. 105 bar

Continue: A08/1

1.3 Notes on how to handle dual-spring nozzle-holder assemblies (with no needle-motion sensor)

Nozzle-and-holder assemblies for direct-injection engines:

On account of special design and hydraulic features, it is possible with such nozzle-and-holder assemblies to solely replace the nozzle. However, only the opening pressure of the first stage is set. This means that – on disassembling the nozzle-and-holder assembly – all parts of the second stage have to be set down complete.

Continue: A08/2

This is done by safely storing the following parts on a mandrel (provided that no damaged parts were removed): Stop sleeve, shim, spring seat, helical compression spring and guide disk. Damaged second-stage parts cannot be replaced with new ones, since the second stage cannot be adjusted. In such cases, the complete nozzle-and-holder assembly is to be renewed.

Continue: A09/1

Notes on how to handle dual-spring nozzle-holder assemblies (with no needle-motion sensor)

Cleaning:

Prior to checking, the entire nozzle-and-holder assembly is to be cleaned in an ultrasonic bath only.

Checking:
Prior to disassembly of the nozzle-and-holder assembly, it is to be checked in the usual manner on a manual test bench. If the check reveals a nozzle defect, it is to be replaced with a new one.

Continue: A09/2

Notes on how to handle dual-spring nozzle-holder assemblies (with no needle-motion sensor)

Dual-spring holders with needle-motion sensor are to be completely replaced if the parts of the nozzle-holder assembly, namely pressure pin, spindle and supporting device, are damaged.

Continue: A10/1

2. SAFETY PRECAUTIONS

The following safety precautions must always be heeded when working with the nozzle tester:

Keep hands away from calibrating-oil jet!

The calibrating-oil jet from a nozzle can penetrate deep into the tissue of the human body.

The high pressure and the ingress of calibrating oil can destroy the tissue structure and possibly result in blood poisoning.

Continue: A10/2

SAFETY PRECAUTIONS

The nozzle tester is only to be used in conjunction with test-pressure lines bent in accordance with bending specification.
There is a danger of line fracture if the test-pressure lines are incorrectly bent.
Calibrating oil and calibrating-oil mist are flammable/explosive.
For this reason, naked flames, cigarettes, sparks and the like are prohibited in the vicinity of the nozzle tester.

Continue: A11/1

SAFETY PRECAUTIONS

The nozzle tester must be operated on pure calibrating oil as per ISO 4113.

Use is never to be made of gasoline or other readily volatile substances.
DANGER OF EXPLOSION!

The nozzle tester is only to be used in conjunction with an extractor such as 0 684 200 702 or 0 684 200 703. The extractor is required to prevent oil mist getting into the ambient atmosphere when nozzles give off spray.

Continue: A12/1

3. Tightening torques fc. assembly and installation

Nozzle-holder assembly type..
KEAL(Z)..P..

Screw connection:

Nozzle tensioning nut	30...40 Nm
Union nut for pressure line	15...25 Nm
Inlet-union screw for leakage connection	5... 7 Nm

Continue: A12/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type:
KDAL(Z)..P..

Screw connection:

Nozzle tensioning nut	30...40 Nm
Union nut for pressure line	15...25 Nm
Inlet-union screw for leakage connection	5... 7 Nm

Continue: A13/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KBEL(Z)..P..

Screw connection:	
Nozzle tensioning nut	40...50 Nm
Union nut for pressure line	15...25 Nm
Inlet connector in holder body	30...45 Nm
Inlet-union screw for leakage connection	1)

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A13/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KDEL(Z)..P..

Screw connection:	
Nozzle tensioning nut	40...50 Nm
Union nut for pressure line	15...25 Nm
Inlet connector in holder body	30...45 Nm
Inlet-union screw for leakage connection	1)

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A14/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KBEL(Z)..S..

Screw connection:	
Nozzle tensioning nut	50...70 Nm
Union nut for pressure line	15...25 Nm
Inlet connector in holder body	30...45 Nm
Inlet-union screw for leakage connection	1)

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A14/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KDEL(Z)..S..

Screw connection:	
Nozzle tensioning nut	50...70 Nm
Union nut for pressure line	15...25 Nm
Inlet connector in holder body	30...45 Nm
Inlet-union screw for leakage connection	1)

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A15/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KB(L)..S..
Screw connection:

Nozzle tensioning nut	70...90 Nm
Union nut for pressure line	15...25 Nm
Inlet connector in holder body	45...65 Nm
Inlet-union screw for leakage connection	1)

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A15/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KB(L)..S..
(continued)

Screw connection:

Screw plug	60...90 Nm
Lock nut for adjusting screw	5...15 Nm
Cap nut	40...60 Nm

Continue: A16/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type:
KBEL(Z)..S..
KBALC..

Screw connection:		
Nozzle tensioning nut		70...80 Nm
Union nut for pressure line		15...25 Nm
Inlet connector in holder body	2)	45...65 Nm
Inlet-union screw for leakage connection	1)	

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A16/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type:
KBAL(Z)..S..

(continued)

2) =
For nozzle-holder assemblies with continuous stem (without pressed-on head) and inlet connector screwed in on side
Tightening torque = 30...45 Nm

Continue: A17/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KDAL(Z)..S..

Screw connection:	
Nozzle tensioning nut	70...90 Nm
Union nut for pressure line	15...25 Nm
Inlet connector 2) in holder body	45...65 Nm
Inlet-union screw for leakage connection 1)	

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A17/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KDAL(Z)..S..

(continued)

2) =
For nozzle-holder assemblies with continuous stem (without pressed-on head) and inlet connector screwed in on side
Tightening torque = 30...45 Nm

Continue: A18/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KCA..S..

Screw connection:

Nozzle tensioning nut	70...90 Nm
Union nut for pressure line	15...25 Nm

Continue: A18/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KB..TA...

Screw connection:

Nozzle tensioning nut	100...140 Nm
Union nut for pressure line	20... 30 Nm
Inlet connector in holder body	3) 90...110 Nm
Inlet-union screw for leakage connection	1) 60...-90 Nm
Screw plug	10... 20 Nm
Lock nut for adjusting screw	40...-60 Nm
Cap nut	

Continue: A19/1

Tightening torques for assembly and installation (continued)

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10 .12Nm

3) =
In the case of inlet connectors with threaded connection M 22x1.5 the tightening torque is 120...140 Nm.

Continue: A19/2

Tightening torques for assembly and installation (continued)
Nozzle-holder assembly type: KBF..T..

Screw connection:	
Nozzle tensioning nut	100...140 Nm
Union nut for pressure line	20... 30 Nm
Inlet connector	3)
in holder body	90...110 Nm
Inlet-union screw for leckage connection	1)
Inlet-union screw for cooling-oil connection	30... 40 Nm
Screw plug	60... 90 Nm
Lock nut for adjusting screw	5... 10 Nm
Cap nut	40... 60 Nm

Continue: A20/1

Tightening torques for assembly and installation (continued)

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

3) =
In the case of inlet connectors with threaded connection M 22x1.5 the tightening torque is 120...140 Nm.

Continue: A20/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KB..U..

Screw connection:	
Nozzle tensioning nut	200...220 Nm
Union nut for pressure line	60... 80 Nm
Inlet connector in holder body	120...140 Nm
Inlet-union screw for leakage connection	1)
Threaded connector for leakage connection	50... 60 Nm
Union nut for leakage connection	2... 8 Nm

Continue: A21/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KS..U.. (continued)

Screw plug	80...100 Nm
Lock nut for adjusting screw	30... 40 Nm
Cap nut	50... 70 Nm

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A21/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KSF..U..

Screw connection:	
Nozzle tensioning nut	200...220 Nm
Union nut for pressure line	60... 80 Nm
Inlet connector in holder body	120...140 Nm
Inlet-union screw for leakage connection	1)
Inlet-union screw for cooling-oil connection	30... 40 Nm
Screw plug	80...100 Nm
Lock nut for adjusting screw	10... 20 Nm

Continue: A22/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KBF..U..
(continued)

Cap nut	50... 70 Nm

1) =
Thread M6x1 =tightening torque= 5...7Nm
Thread M8x1 =tightening torque= 7...9Nm
Thread M10x1=tightening torque=10..12Nm

Continue: A22/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type:
KBAL(Z)..P..

Screw connection:

Screws for 4) securing flange	10...20 Nm

4) = Pay attention to engine-manufacturer's manual as regards claw attachment.

Continue: A23/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KCAL(Z)..P..

Screw connection:

Retaining screw in cylinder head	50...60 Nm

Continue: A23/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KBEL(Z)..P..

Screw connection:

Screws for 4) securing flange	10...20 Nm

Important: The tightening torque must be applied alternately to the two nuts. Attention is to be paid in the process to the position of the flange with respect to the nozzle-holder assembly (90 Grad).

Continue: A24/1

Tightening torques for assembly and installation (continued)

In the event of one-sided tightening of one nut only, considerably more stress is produced in the flange due to incorrect clamping than is the case with proper installation. There is also a danger that the stay bolt will bend outwards.

4) = Pay attention to engine-manufacturer's manual as regards claw attachment.

Continue: A24/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KDEL(Z)..P..

Screw connection:

Retaining screw in cylinder head	60...80 Nm
With undercut nozzle tensioning nut	50...70 Nm

Continue: A25/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KSEL(Z)...

Screw connection:

Screws for securing flange 4)	10...20 Nm

Important: The tightening torque must be applied alternately to the two nuts. Attention is to be paid in the process to the position of the flange with respect to the nozzle-holder assembly (90 Grad).

Continue: A25/2

Tightening torques for assembly and installation (continued)

In the event of one-sided tightening of one nut only, considerably more stress is produced in the flange due to incorrect clamping than is the case with proper installation. There is also a danger that the stay bolt will bend outwards.

4) = Pay attention to engine-manufacturer's manual as regards claw attachment.

Continue: A25/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KBEL(Z)...S..

Screw connection:

Retaining screw for cylinder head	60...80 Nm

Continue: A26/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type: KBEL(Z)...S..

Screw connection:

Screws for securing flange 4)	10...20 Nm

4) = Pay attention to engine manufacturer's manual or instructions regarding this point.

Continue: A27/1

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type:
KDAL(Z)..S..

Screw connection:

Retaining screw in cylinder head 60...80 Nm

Continue: 27/2

Tightening torques for assembly and installation (continued)

Nozzle-holder assembly type:
KDAL(Z)..S..

Screw connection:

Retaining screw in cylinder head 60...80 Nm

Continue: 28/2

[illegible] nozzle for assembly
in cylinder head

Nozzle-holder assembly type: KC...S...

Screw connection:

Nozzle-holder assembly
in cylinder head 60...80 Nm

Continue: B01/1

TOOLS AND DEVICES, CALIBRATING OIL

Ultrasonic cleaning unit
Service Stations in Germany:

- Cleaning unit
  SONOREX SUPER RK 102 H

- Insert (part no. 363 K3)
- Insert (part no. 37J KD 0)
- Cover (part no. 343 D 38)

manufactured by
BANDELIN electronic
Postfach 45 01 60
1000 Berlin 45

Continue: BC1/2

TOOLS AND DEVICES, CALIBRATING OIL

Cleaning agent
Neodisher LM10

manufactured by
Dr. Weigert GmbH
Chemische Fabrik
Postfach 28 01 27
2000 Hamburg 28

Service Stations outside Germany may
also use devices and cleaning agents
produced locally.

Continue: B02/1

TOOLS AND DEVICES, CALIBRATING OIL

Nozzle cleaner	KDEP 2900
Assembly device	KDEP 1043 *)
Illuminating magnifier	0 681 104 000
or	1 987 600 005
Nozzle tester	0 681 200 502
or	0 684 200 704
in line with ISO 9984	
Needle tester	1 688 130 153
Quick-clamping device for nozzles, size R	0 681 243 006
Quick-clamping device for nozzles, size S	0 681 243 003
Quick-clamping device for nozzles, size T	0 681 243 004

Continue: B02/2

TOOLS AND DEVICES, CALIBRATING OIL

*) An appropriate hole is to be made in the support plate KDEP 1043 /0/1 of older assembly devices for accommodating KCA holders.

Universal nozzle holder for nozzles, size R	0 431 101 010
Universal nozzle holder for nozzles, size S	0 681 243 005
Universal nozzle holder for nozzles, size T	0 681 343 002
Extractor	0 684 200 702
or	0 684 200 703

Continue: B03/1

TOOLS AND DEVICES, CALIBRATING OIL

If the nozzle tester 0 684 209 704 (EPS 100) is to be used as a substitute for nozzle tester 0 681 200 502 (EFEP 60H), the intermediate plate 1 682 310 086 is required as special accessory with the hole pattern from 0 684 200 709 to 0 681 200 502.

Calibrating oil as per ISO 4113 or diesel fuel.

N o t e :
The test does not conform to the Standard ISO 8984/1 if use is made of diesel fuel.

Continue: B03/2

5. MAINTENANCE INSTRUCTIONS

The following function checks are to be performed every six months within the scope of maintenance:

Freedom from leaks of entire system.

Freedom from leaks of pump plunger and inlet valve/pump opening

Freedom from leaks of shut-off valve and check valve

Function and accuracy of pressure gauge

Continue: B04/1

Maintenance instructions

Replacement of the pressure gauge on the nozzle tester 0 684 200 704 (EPS 100) requires a reference pressure gauge and a volume gauge for measuring the defined volume error.

The following requirements must be satisfied with all function checks:

Test medium: Calibrating oil as per ISO 4113
Calibrating oil temperature:
18...28 Grad C
A prerequisite for precise results with all measurements is complete bleeding of the entire system.

Continue: BC4/2

Maintenance instructions

Bleeding:

To effect bleeding, the nozzle tester must be scavenged with at least 10 movements of the pump lever (full travel) with a nozzle holder assembly connected up.

It is important that all the air be flushed out or disolved in the calibrating oil. To disolve any air which may still be present in the calibrating oil, the system is to be subjected to 100 bar for at least one hour. If the hydraulic system is opened up anywhere during a test, the entire bleeding procedure must be repeated.

Continue: BC5/1

Maintenance instructions

Freedom from leaks of entire system:
Close shut-off valve so as to separate pressure gauge from system pressure. High pressure peaks could damage the pressure gauge!
The locking piece forming part of the nozzle tester is to be screwed onto the fitting but not tightened.
Scavenge/bleed unit by moving pump lever. Tighten locking piece to a torque of 50...60 Nm. Open shut-off valve and increase system pressure to 400 bar.

Continue: B05/2

Maintenance instructions

This pressure may be "topped up" as often as desired within 30 minutes.

The drop in system pressure is to be measured within one minute. When doing so, the pump lever should be in the initial position (top, not pressed through).
The drop in pressure should not exceed 1 bar in one minute.

Continue: B06/1

Maintenance instructions

Freedom from leaks of plunger and inlet valve:

Bleed entire system. Seal off fitting with locking piece provided. Increase system pressure to 150 bar with pump lever with shut-off valve open. When system pressure of 150 bar is being applied, slowly press down pump lever (approx. 1/3 of a stroke per second). The system pressure of 150 bar must increase during movement of the pump lever. The system pressure should not remain the same or drop off.

Continue: B06/2

Maintenance instructions

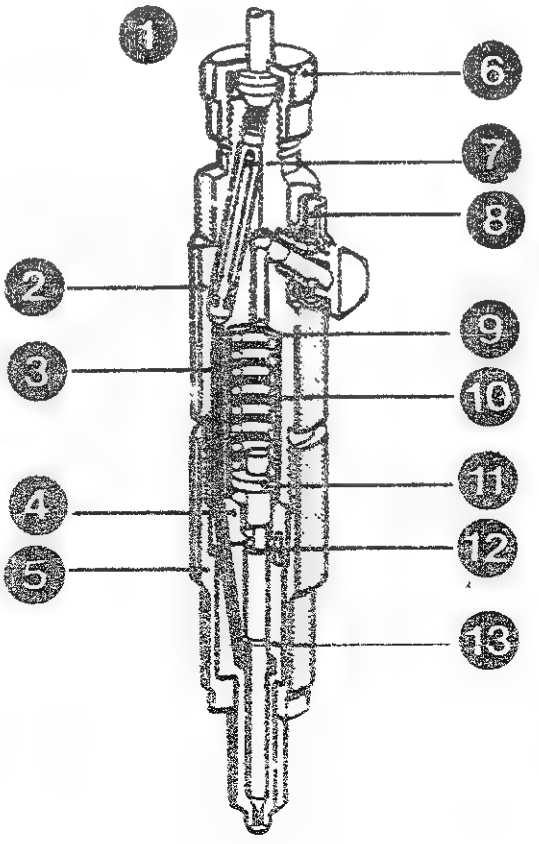
Freedom from leaks of shut-off valve and check valve
Fully dissipate system pressure in nozzle tester by opening locking piece and shut-off valve.
Close shut-off valve and scavenge/ bleed system by moving pump lever.
Close off fitting with locking piece.
A system pressure is built up by movement of the pump lever.
The pressure gauge should not indicate any pressure.

Continue: B07/1

SECTIONAL VIEW OF NOZZLE-HOLDER ASSEMBLY

1 = Inlet
2 = Supporting device
3 = Pressure duct
4 = Intermediate plate
5 = Nozzle tensioning nut
6 = Union nut for pressure line
7 = Edge-type filter
8 = Leakage-fuel connection
9 = Shims
10 = Helical compression spring
11 = Spindle
12 = Positioning pins (positioning of nozzles)
13 = Injection nozzle

Continue: C01/1 Fig.: B07/2



KMK 01916

6. DISMANTLING KCA.., KCE NOZZLE-AND-HOLDER ASSEMBLIES

Prior to disassembly, use nozzle tester to check the complete nozzle-and-holder assembly removed from the engine, place in cold cleaner if necessary and clean in ultrasonic cleaning unit.

Continue: C02/1

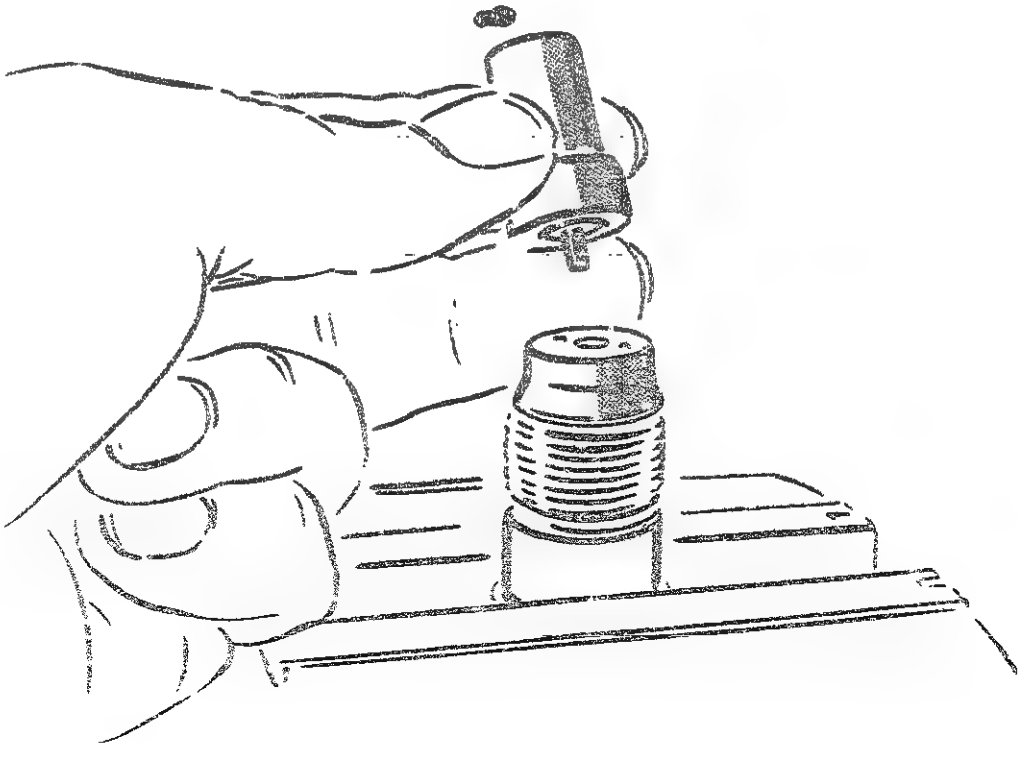
DISMANTLING KCA.., KCE NOZZLE-AND-HOLDER ASSEMBLIES

Clamp complete nozzle-and-holder assembly in vice (use protective jaws) such that nozzle faces upwards.

Loosen and unscrew nozzle tensioning nut.

Remove nozzle, intermediate plate, spindle, helical compression spring and shim from supporting device and set down (take care not to damage sealing surface).

Continue: C03/1 Fig.: C02/2

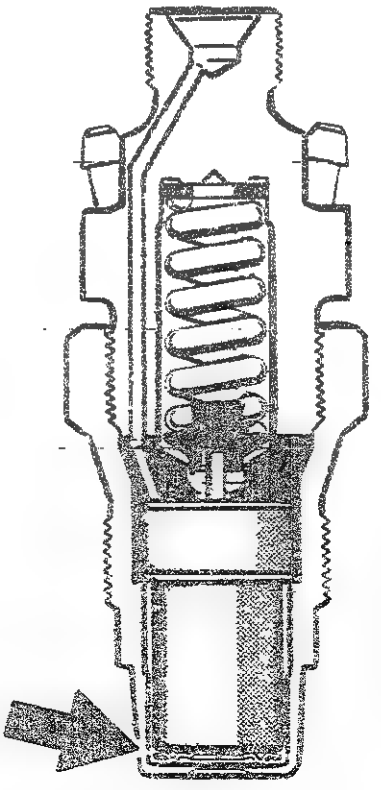


KMK 01917

DISMANTLING KCA.., KCE NOZZLE-AND-HOLDER ASSEMBLIES

In the case of nozzle-and-holder assemblies with inlaid thermal-insulation washer in nozzle tensioning nut (arrow), the washer is always to be replaced with a new one.

Continue: C04/1 Fig.: C03/2



KMK 01918

6.1 Cleaning

Clean new nozzles in calibrating oil as per ISO 4113 or diesel fuel.
Clean individual parts of dismantled nozzle-holder assembly and used nozzles in ultrasonic cleaning unit.
Pay attention to the following operating instructions:
The cleaning fluid is to be diluted in a volume ratio of 1:20 with water.
Heat up cleaning bath to approx. 45 Grad C
The parts to be cleaned must be completely covered by the cleaning fluid.

Continue: C04/2

Cleaning

The cleaning time depends on the contamination level, but should be at least 10 minutes.
Immediately after cleaning, wash off parts in cold cleaner, blow dry with compressed air and immerse in calibrating oil.
When cleaning nozzles, pull needle completely out of body and clean both parts separately.
In doing so, the nozzle body is to be cleaned as vertically as possible with the holes facing downwards.
Make sure that needle and body are not mixed up with parts from other nozzles.

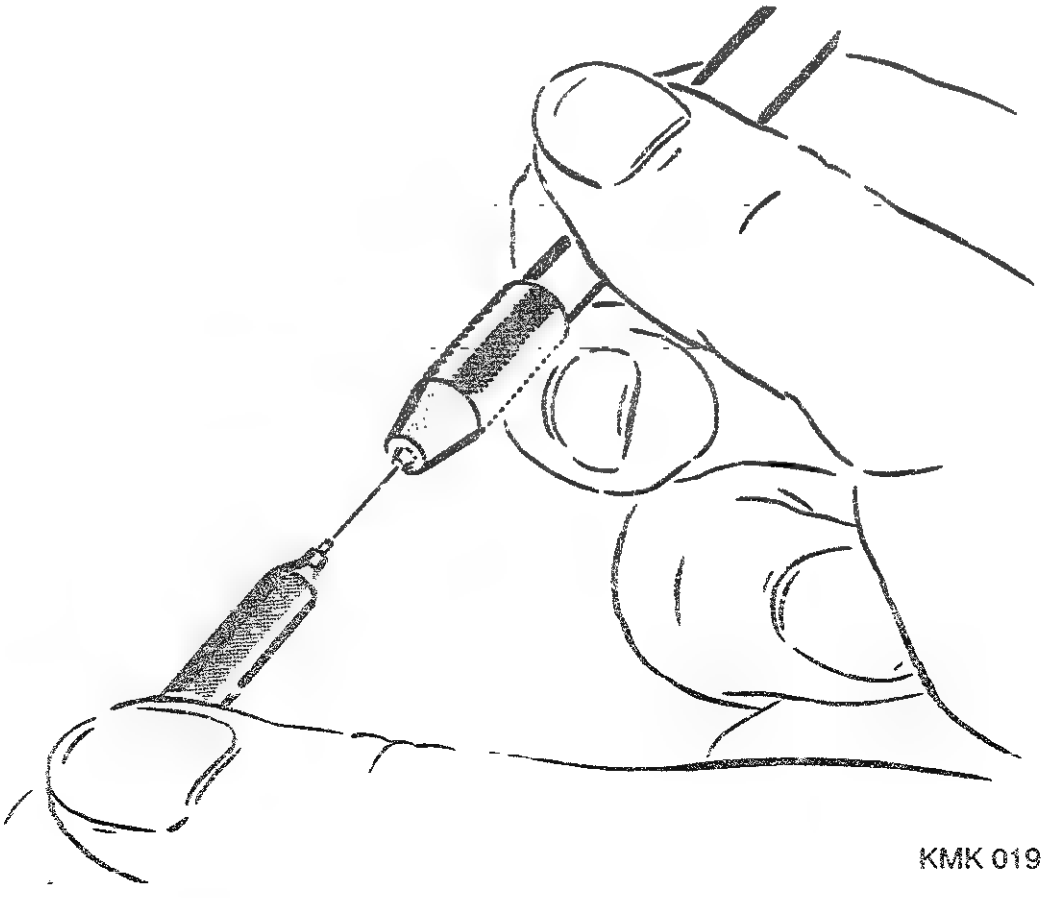
Continue: C05/1

Cleaning

Following ultrasonic cleaning:
Remove combustion residue from axial hole in pintle of needle of hole-type pintle nozzles in line with hole diameter using cleaning needle KDEP 2900/5
(needle diameter 0.18 mm for hole diameter 0.20 mm) or
KDEP 2900/3
(needle diameter 0.15 mm for hole diameter 0.18 mm).

Use cleaning needle KDEP 2900/13 to clean transverse hole.

Continue: C06/1 Fig.: C05/2



KMK 01919

Cleaning

Then immerse nozzle needle in clean calibrating oil or diesel fuel and insert in nozzle body.

Continue: C07/1

6.2 Visual inspection of pintle nozzles

After being cleaned, subject used nozzles to visual inspection.

In this process, the following is not permitted for the nozzle needle:

* Damaged or rough needle seat
* Broken-off or damaged pintle
* Coked transverse and axial hole in pintle (hole-type pintle nozzle)

Continue: C07/2

Visual inspection of pintle nozzles

Examine nozzle body with illuminating magnifier 0 681 104 000 for worn or coked seat.

The hole must be round and likewise not coked.

I m p o r t a n t :

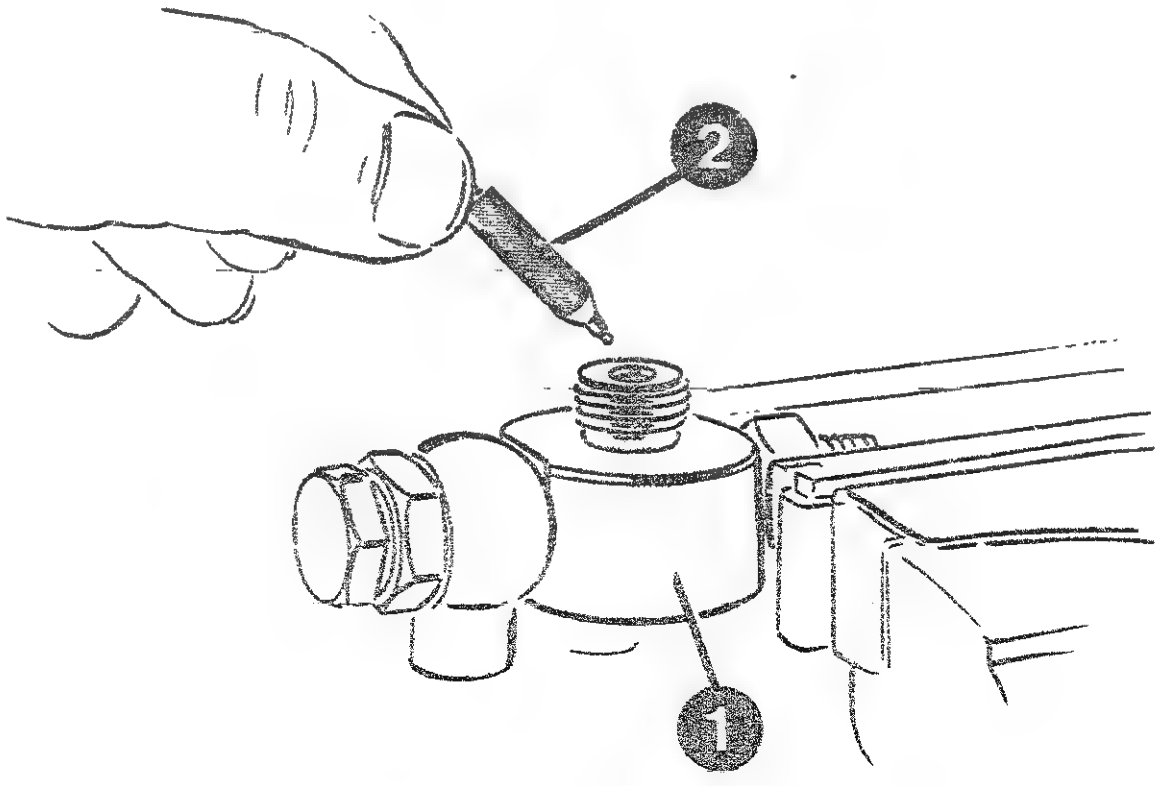
Needles of flat-type pintle nozzles feature a ground surface which is not to be viewed as damage.

Continue: C08/1

6.3 Checking transverse and axial hole in pintle or nozzle needle of hole-type pintle nozzles

Insert nozzle needle into tester 1 688 130 153 and tighten clamping nut by hand.

Continue: C09/1 Fig.: C08/2



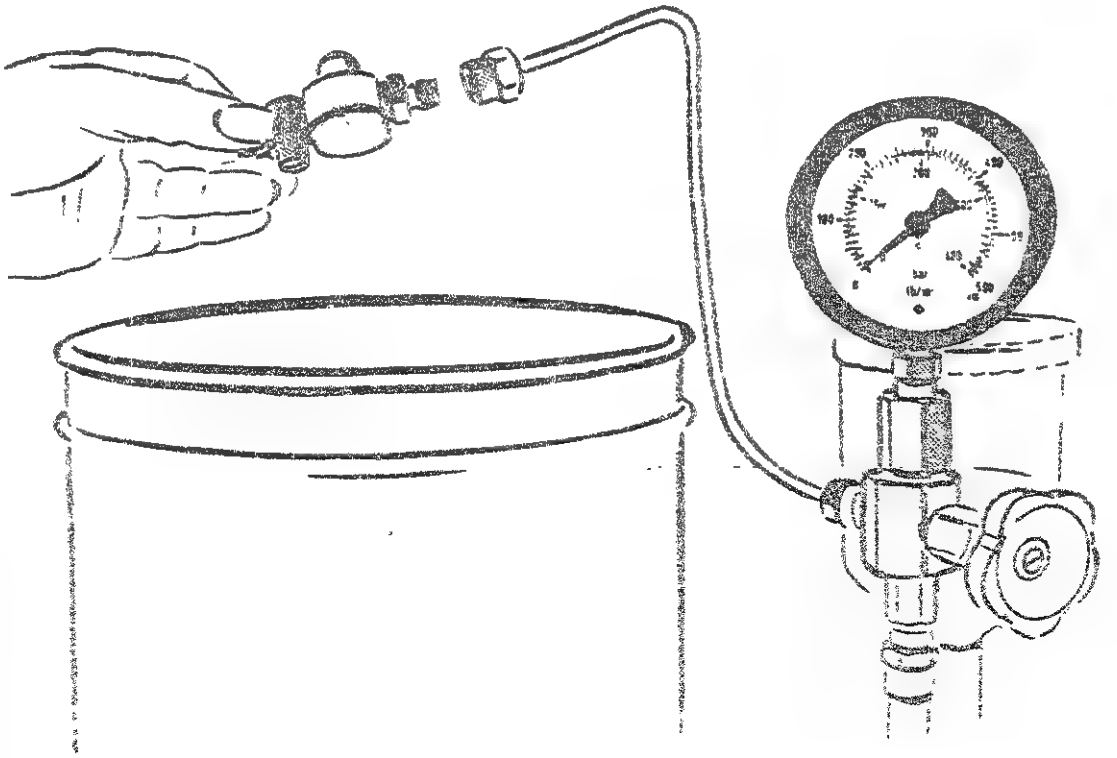
KMK 01920

Checking transverse or axial hole in pintle or nozzle needle of hole-type pintle nozzles

Connect up needle tester 1 688 130 153 to nozzle tester 0 681 200 502.

Operate pump lever and increase pressure until calibrating oil emerges at overflow valve of needle tester.

Continue: C10/1 Fig.: C09/2



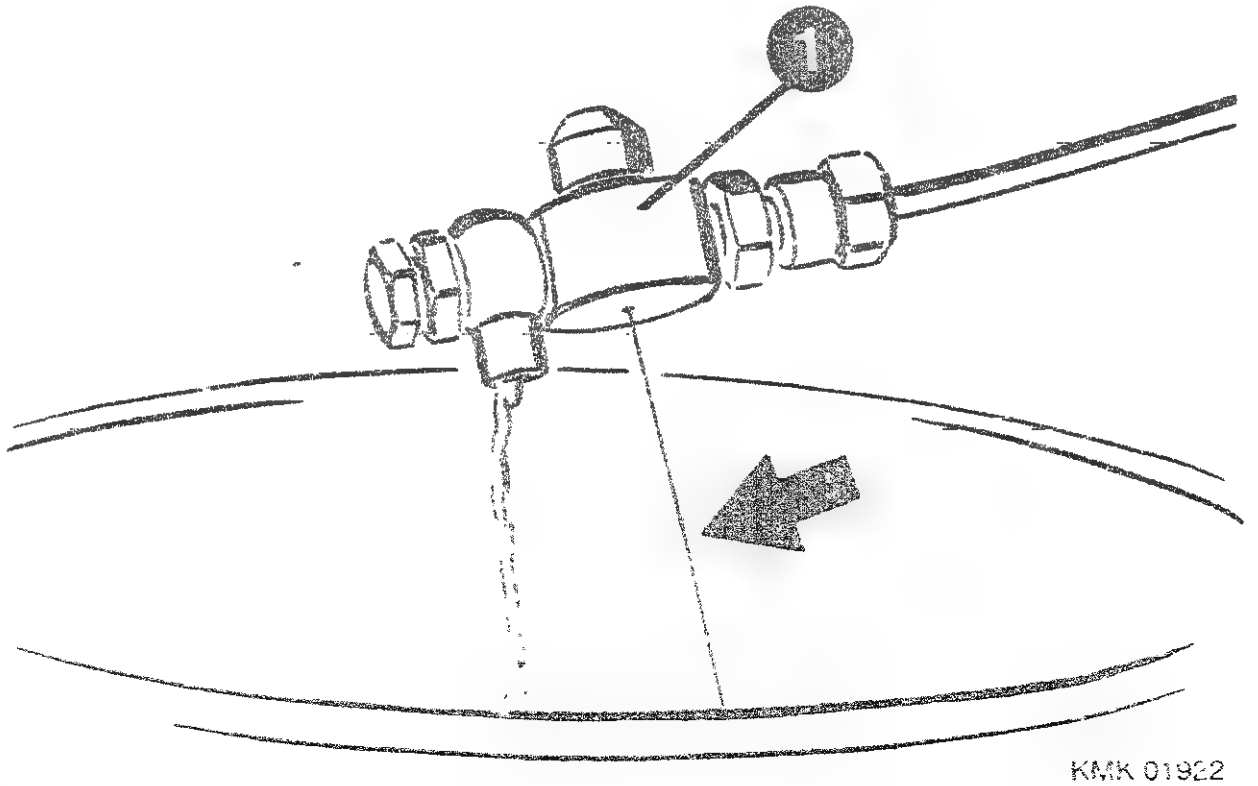
KMK 0'921

Checking transverse or axial hole in pintle or nozzle needle of hole-type pintle nozzles

Continued uniform and slow movement of the lever (4...6 seconds for one downward stroke of the hand lever) must cause a fine, clear, axial cord-like spray to emerge from the axial hole in the pintle of the nozzle needle.

If no cord-like spray is visible, the axial hole must be cleaned with the appropriate cleaning needle of the nozzle cleaner or the complete nozzle is to be renewed.

Continue: C11/1 Fig.: C10/2



Checking transverse or axial hole in pintle or nozzle needle of hole-type pintle nozzles

Unscrew clamping nut of needle tester.

Remove nozzle needle from tester and insert into appropriate body.

I m p o r t a n t :

Nozzle needle and nozzle body are paired and must therefore not be interchanged!

Continue: C12/1

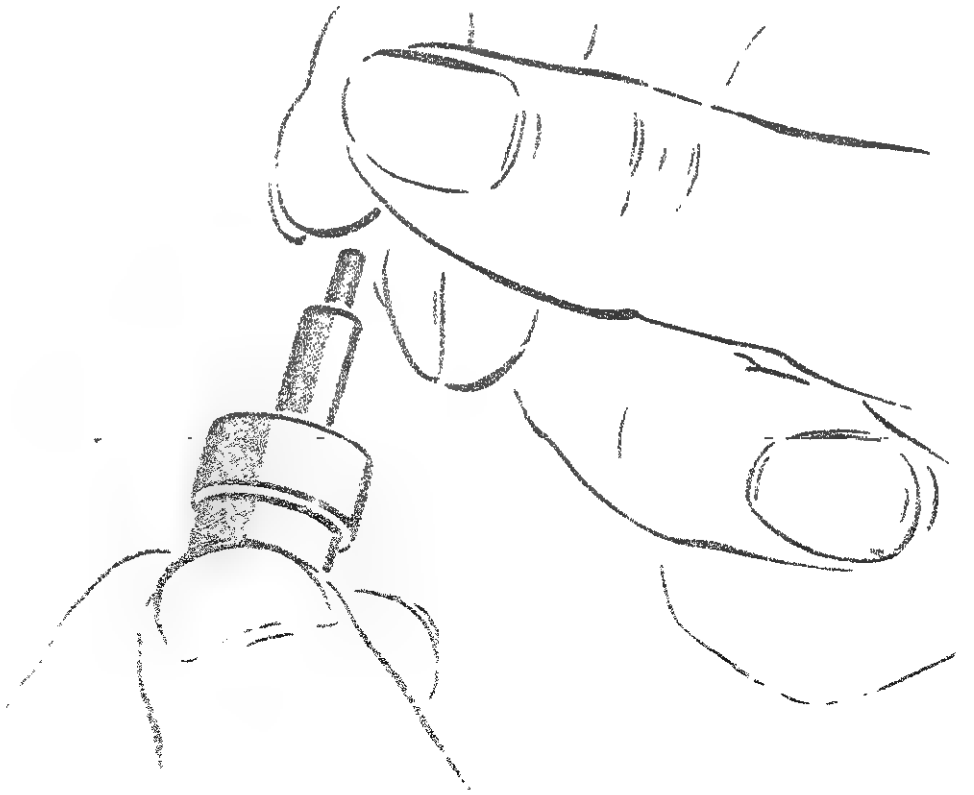
6.4 Slide test

A slide test is to be performed on all nozzles (new and used) following visual inspection.

The nozzle needle, which has previously been immersed in clean calibrating oil or diesel fuel and inserted in the nozzle body, is to be pulled by hand up to 1/3 of its guide out of the virtually perpendicular nozzle body.

On being released, its own weight must cause it to slide back onto its seat.

Continue: C13/1 Fig.: C12/2



KMK 01923

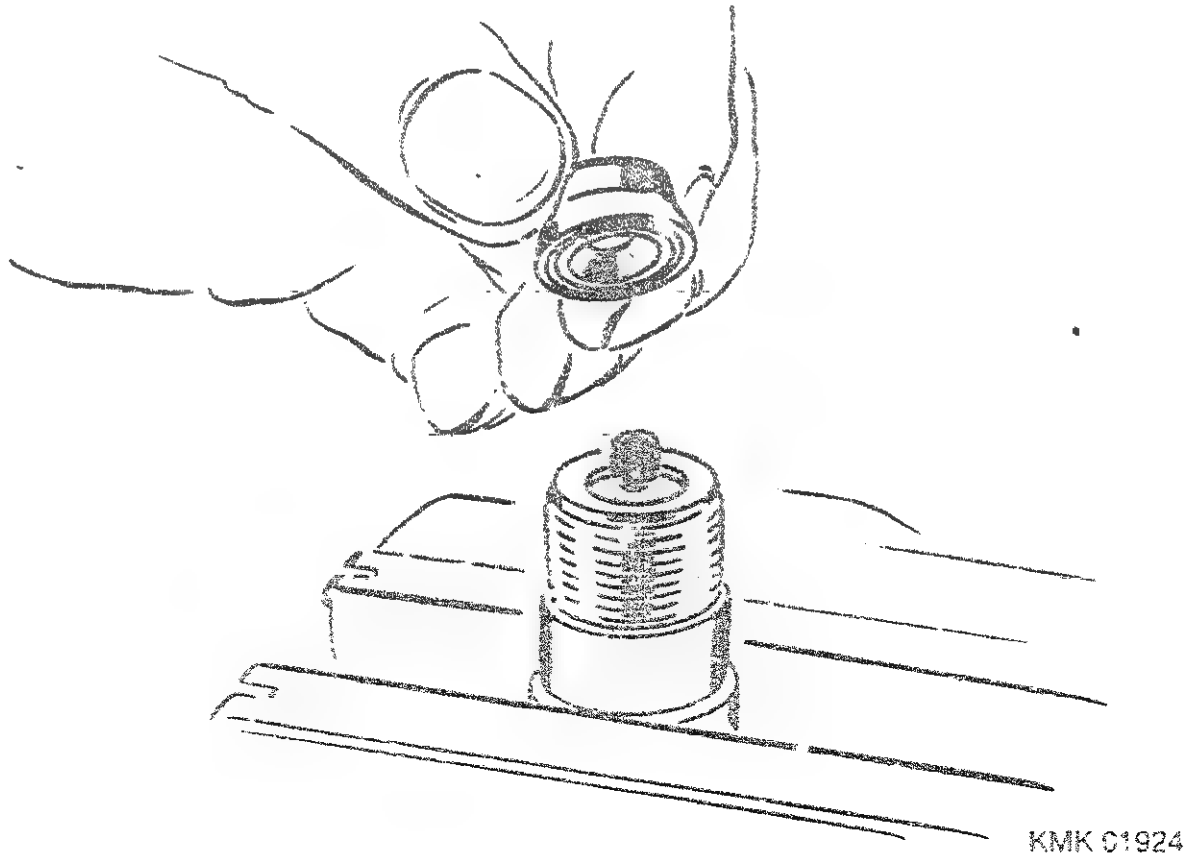
6.5 Assembling nozzle-and-holder assembly

Install all parts of nozzle-holder assembly in nozzle body as per service-parts list.

Place nozzle on clean sealing surface of intermediate plate.

In the case of nozzle-holder assemblies with set pins, align nozzles such that set pins of holder are properly introduced into set-pin holes in nozzle.

Continue: C14/1 Fig.: C13/2

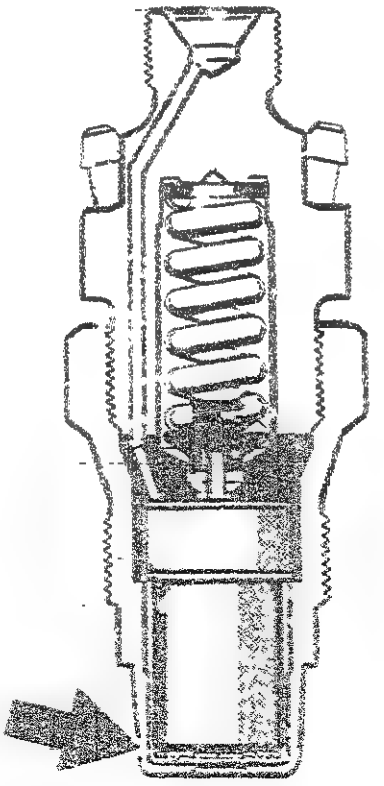


Assembling nozzle-and-holder assembly

In the case of nozzle-holder assemblies with thermal-insulation washer in the nozzle tensioning nut (see picture, arrow), the washer is not yet to be installed.

In view of the fact that it can only be used once, it is not inserted into the nozzle tensioning nut until pressure adjustment has been completed.

Continue: C15/1 Fig.: C14/2



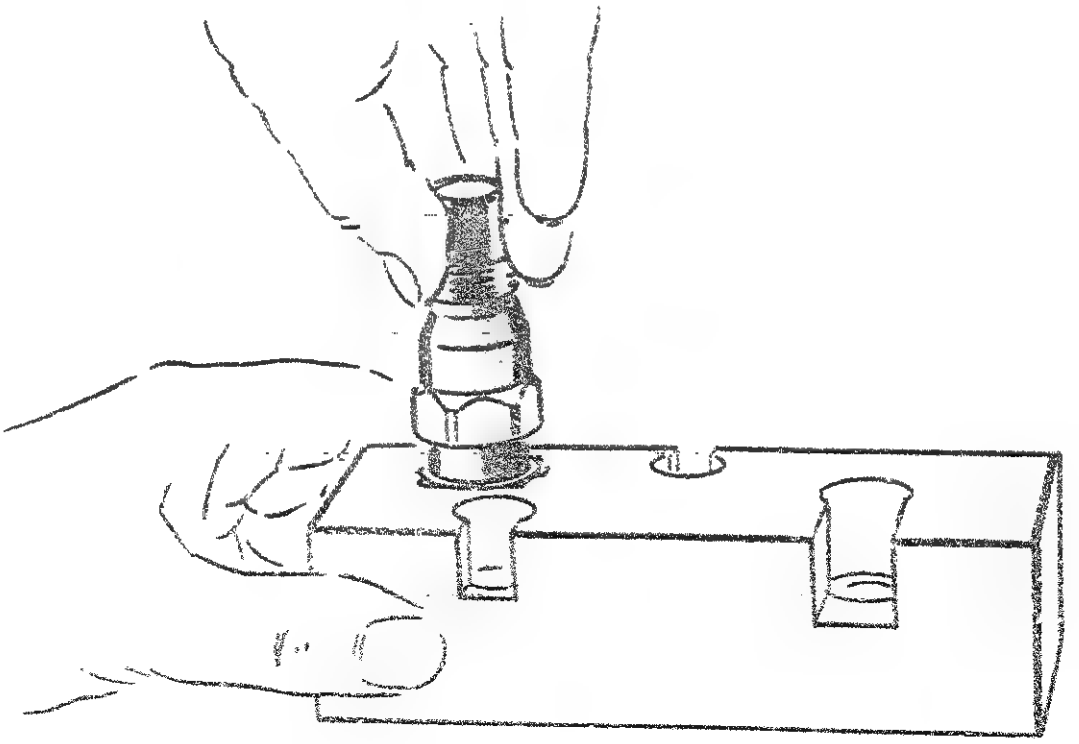
KMK 01918

Assembling nozzle-and-holder assembly

Screw nozzle tensioning nut onto supporting device.

Before it makes contact with the nozzle, the complete nozzle-and-holder assembly is to be inserted into the recess provided for this purpose in the support plate KDEP 1043/0/1 (see picture).

Continue: C16/1 Fig.: C15/2



KMK 01925

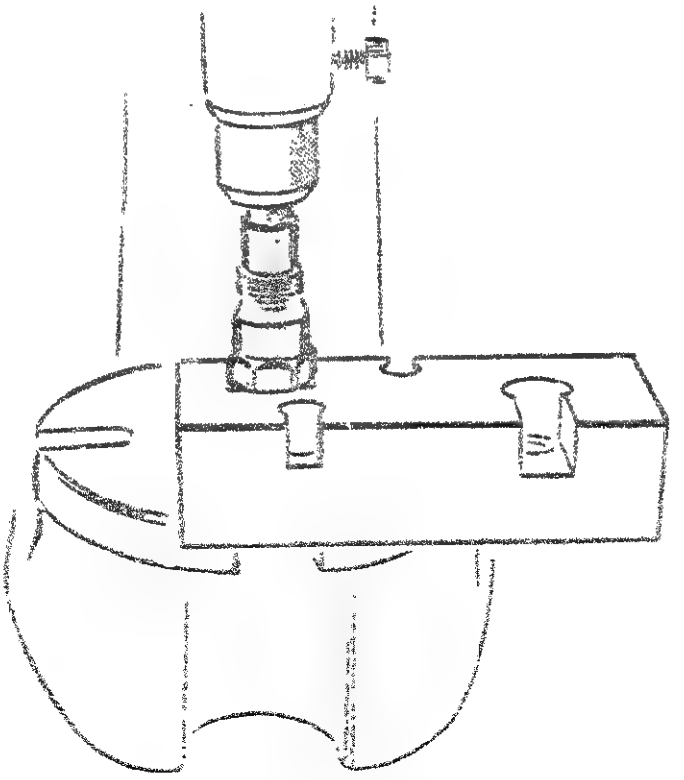
Assembling nozzle-and-holder assembly

Insert suitable thrust piece of assembly device KDEP 1043 into drill chuck of bench drill or punch mount of hand press.

Position support plate with inserted nozzle-and-holder assembly under thrust piece such that thrust piece presses against bottom of nozzle (see picture).

Relieve tension on nut by pressing on nozzle and screw as far as possible onto supporting device.

Continue: C17/1 Fig.: C16/2



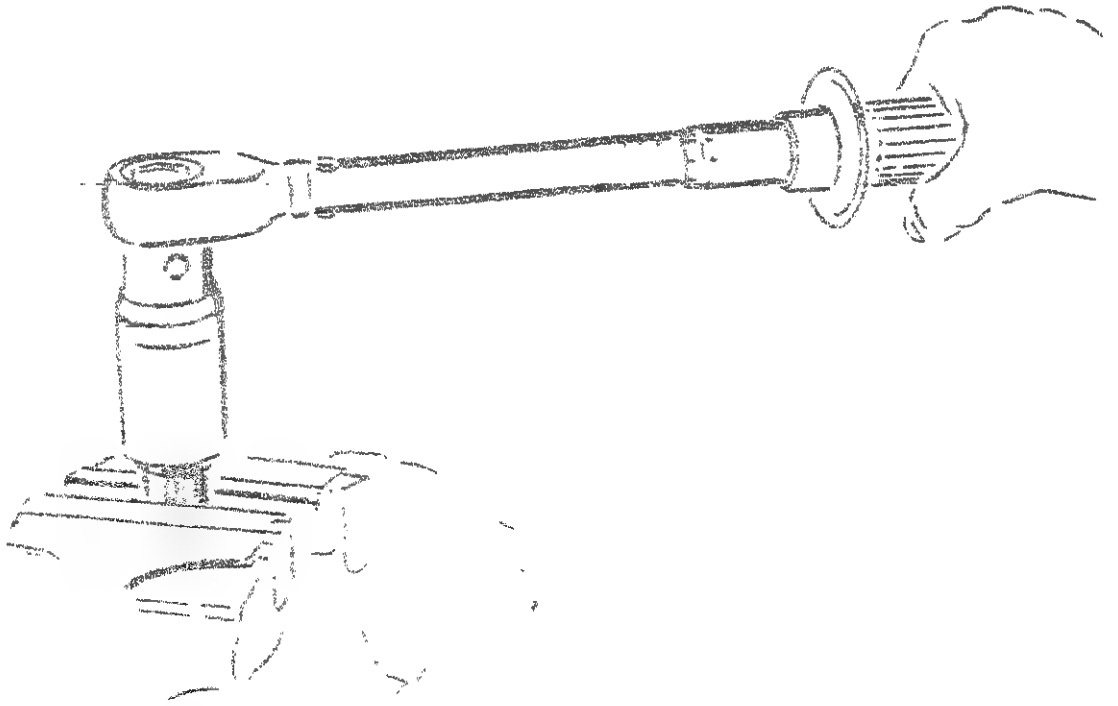
KMK 0:926

Assembling nozzle-and-holder assembly

Then remove complete nozzle-and-holder assembly from support plate and clamp in position in vice (use protective jaws!).

Use socket wrench and torque wrench to tighten nozzle tensioning nut to prescribed tightening torque 70...90 Nm (KCA) or 60...80 Nm (KCE).

Continue: C18/1 Fig.: C17/2



KMK 01927

7. DISMANTLING KB..-, KD..- AND KE NOZZLE-AND-HOLDER ASSEMBLIES (Single-spring holder)

Prior to disassembly, check complete nozzle-and-holder assembly removed from engine, place in cold cleaner if necessary and clean in ultrasonic cleaning unit.

Continue: C19/1

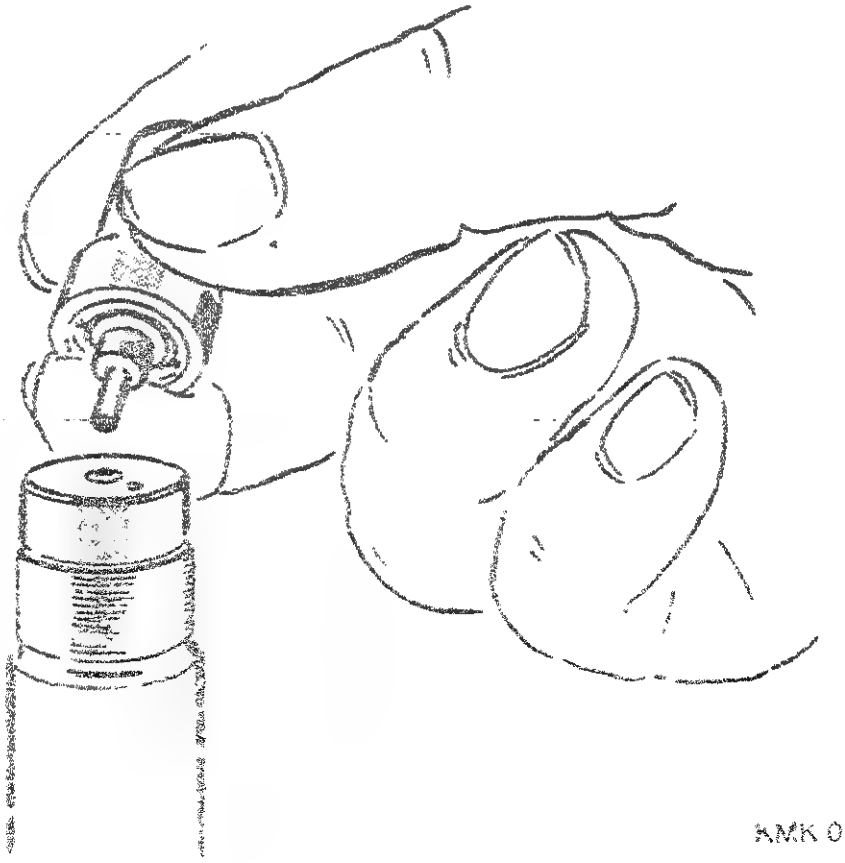
DISMANTLING KB..-, KD..- AND KE NOZZLE-AND-HOLDER ASSEMBLIES

Clamp complete nozzle-and-holder assembly in vice (use protective jaws!) such that nozzle faces upwards (see picture).

Loosen and unscrew nozzle tensioning nut.

Remove nozzle, intermediate plate, spindle, helical compression spring and shim from supporting device and set down (take care not to damage sealing surface).

Continue: C20/1 Fig.: C19/2



AMK 01926

Disassembling KSEL..-, KSEL..- ..ucl-
spring nozzle-holder assemblies:

Clamp nozzle-and-holder assembly
in position. Loosen and unscrew
tensioning nut. Remove and set down
nozzle. Remove second-stage parts and
store complete on mandrel. Remove
first-stage parts. Clean all parts and
examine for possible re-use. Damaged
first-stage parts are to be replaced
with new ones.

Continue: C21/1

7.1 Cleaning

Clean new nozzles in calibrating oil as per ISO 4113 or diesel fuel.
Clean individual components of disassembled nozzle holder and used nozzles in ultrasonic cleaning unit.
Attention is to be paid to the following operating instructions:
Dilute cleaning fluid with water in a volume ratio of 1:20.
Heat up cleaning bath to approx. 45 Grad C.
The parts to be cleaned must be completely covered by the cleaning fluid.

Continue: C21/2

Cleaning

The cleaning time depends on the contamination level, but should be at least 10 minutes.
Immediately after cleaning, wash off parts in cold cleaner, blow dry with compressed air and immerse in calibrating oil.
When cleaning nozzles, pull needle completely out of body and clean both parts separately.
In doing so, the nozzle body is to be cleaned as vertically as possible with the holes facing downwards.
Make sure that needle and body are not mixed up with parts from other nozzles.

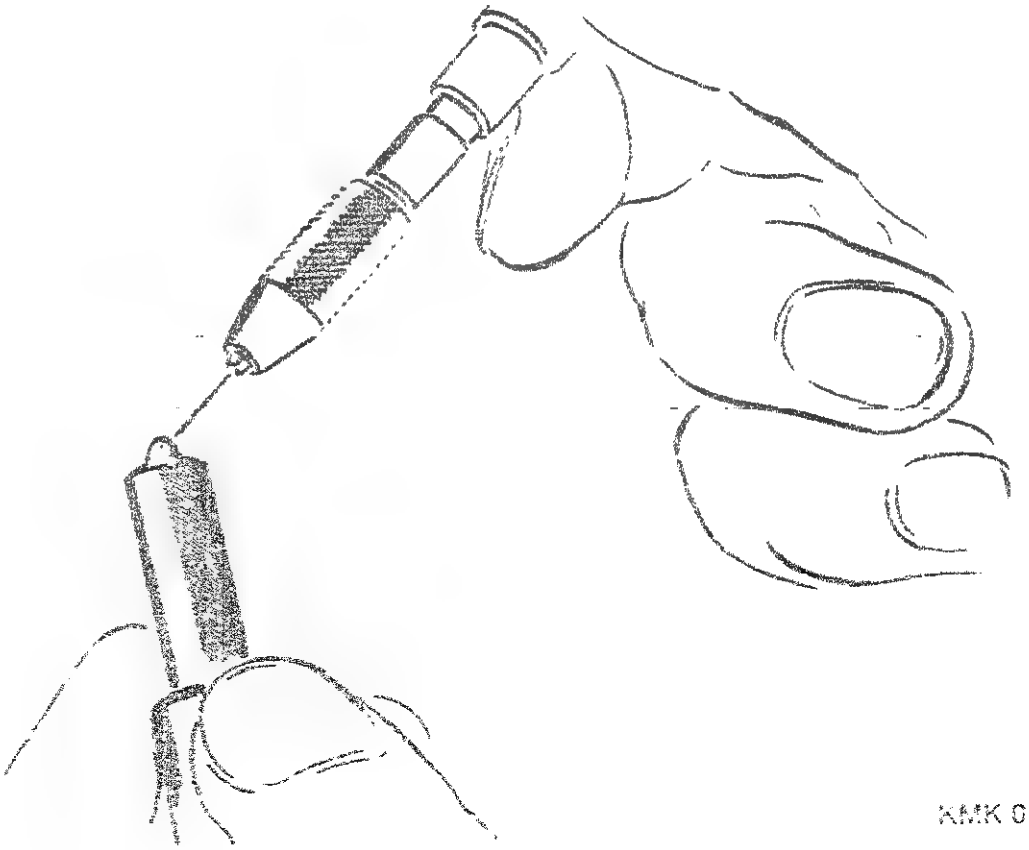
Continue: C22/1

Cleaning

After cleaning in ultrasonic cleaning bath, stubborn dirt in the holes can be removed with the appropriate cleaning needle of the nozzle cleaner KDEP 2900.

Then immerse nozzle needle in clean calibrating oil or diesel fuel and insert into nozzle body.

Continue: C23/1 Fig.: C22/2



KMK 01329

7.2 Visual inspection of pole-type nozzles

After cleaning, used nozzles are to be subjected to a visual inspection.

If the needle seat of the nozzle needle is damaged or rough, renew complete nozzle.

Examine nozzle body with illumirating magnifier 0 681 104 000 for worn or coked seat.

Likewise examine holes for coking or other clogging.

Continue: C24/1

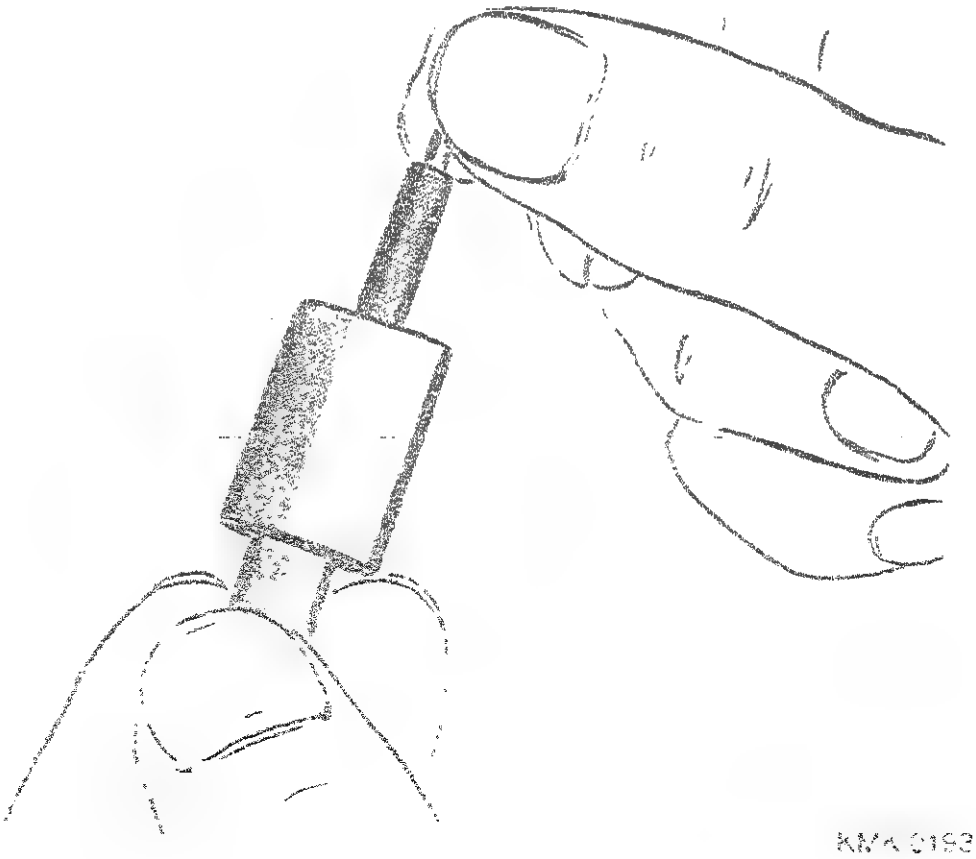
7.3 Slide test

A slide test is to be performed on all nozzles (new and used) following visual inspection.

The nozzle needle, which has previously been immersed in clear calibrating oil or diesel fuel and inserted in the nozzle body, is to be pulled by hand up to 1/3 of its guide out of the virtually perpendicular nozzle body.

On being released, its own weight must cause it to slide back onto its seat.

Continue: C25/1 Fig.: C24/2



KMA 01933

7.1 Assembling nozzle-and-holder assembly (single-spring holder)

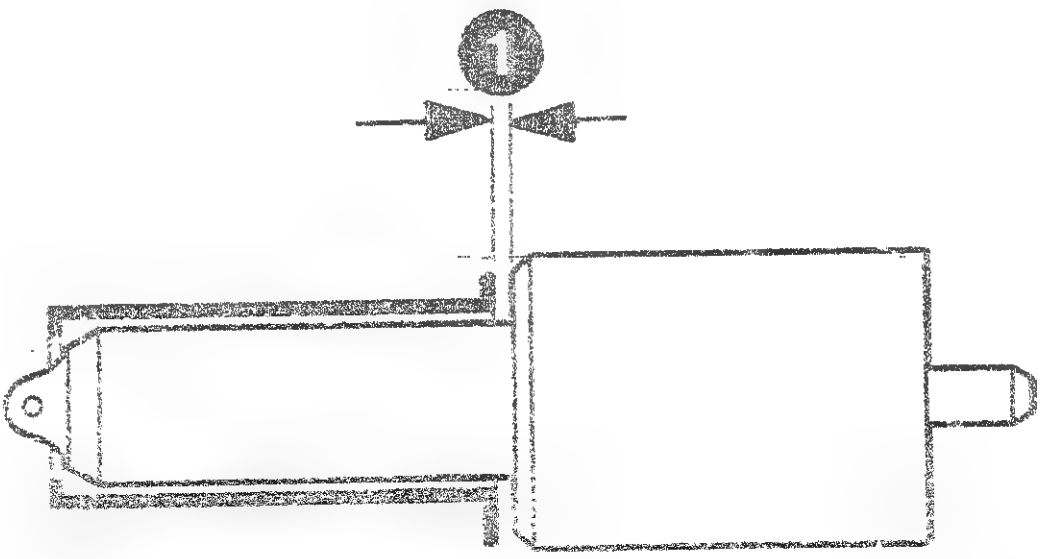
Notes for nozzle-and-holder assemblies with thermal-insulation sleeve

Thermal-insulation sleeves are to be renewed whenever nozzle-and-holder assembly has been dismantled.

The gap between thermal-insulation sleeve and nozzle body must be 0.1...0.55 mm.
Check prior to assembly.

1 = Gap 0.1...0.55 mm

Continue: C26/1 Fig.: C25/2



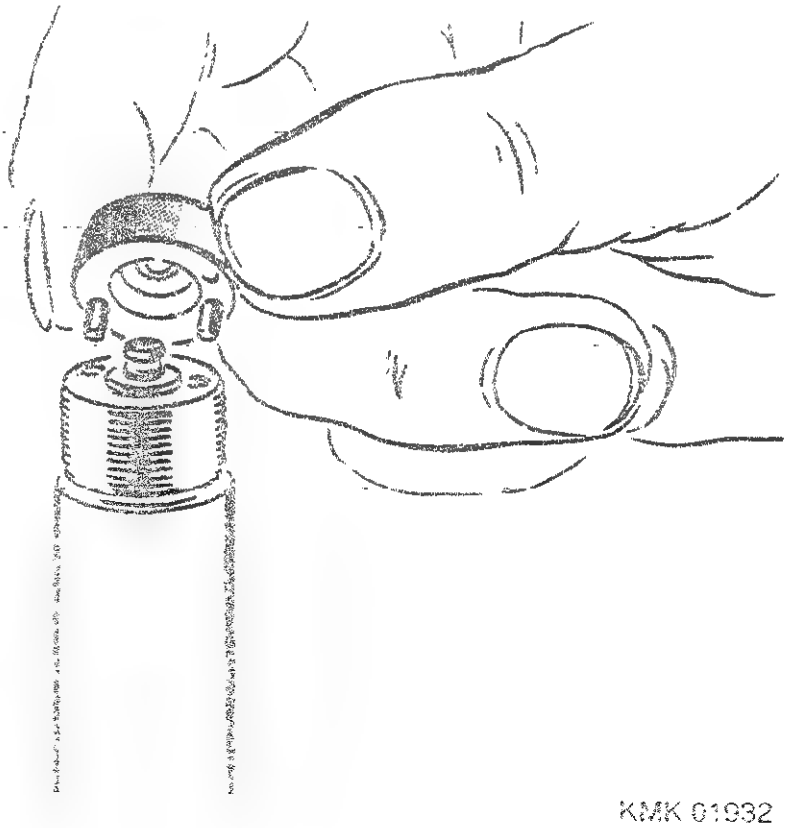
Assembling nozzle-and-holder assembly (single-spring holder)

Install all parts of nozzle-holder assembly in nozzle body as per service-parts list.

Place nozzle on clean sealing surface of intermediate plate.

In the case of nozzle-holder assemblies with set pins, align nozzles such that set pins of holder are properly introduced into set-pin holes in nozzle.

Continue: C27/1 Fig.: C26/2



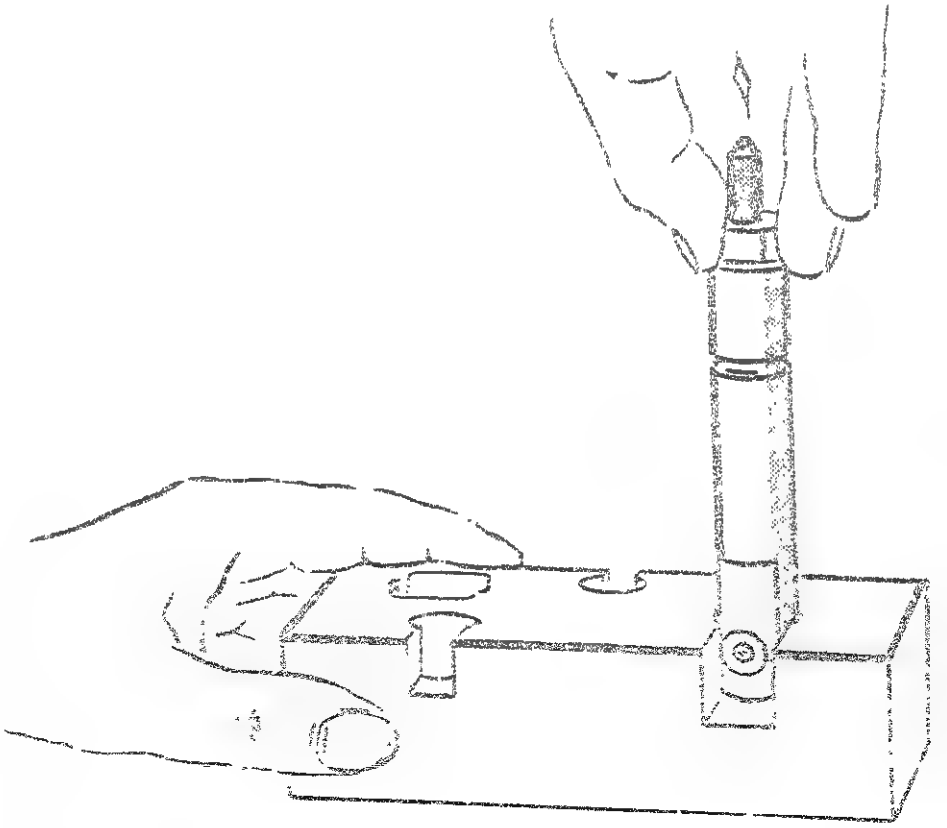
KMK 01932

Assembling nozzle-and-holder assembly (single-spring holder)

Screw nozzle tensioning nut onto supporting device.

Before it makes contact with nozzle, the complete nozzle-and-holder assembly is to be inserted into the recess provided for this purpose in the support plate KDEP 1043/0/1.

Continue: C23/1 Fig.: C27/2



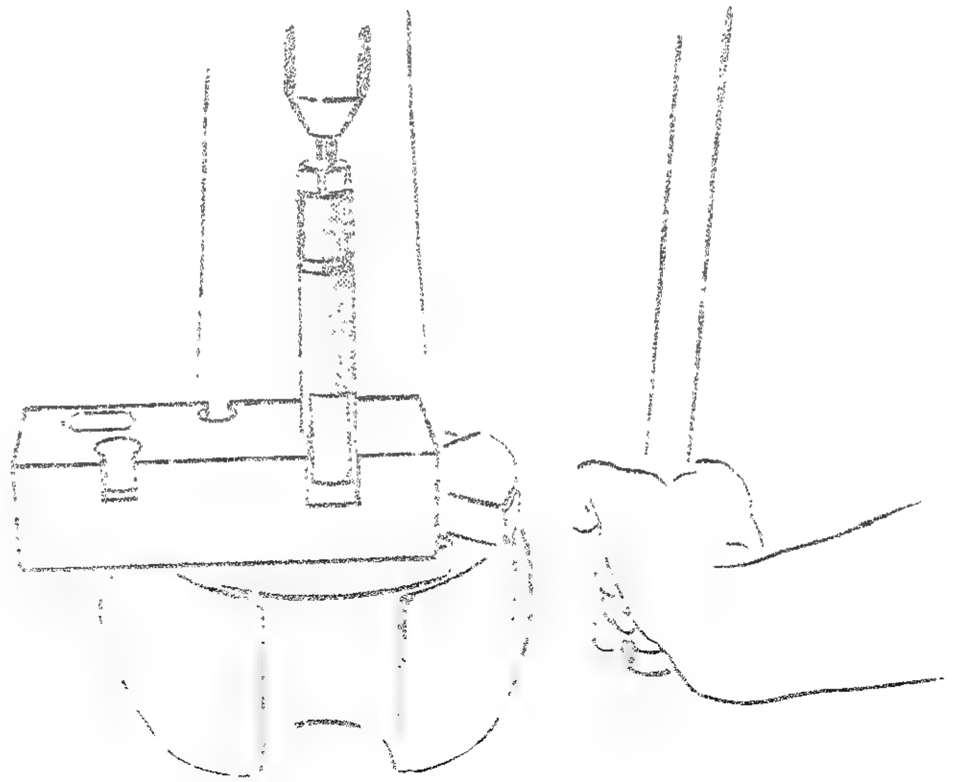
KMK 31933

Assembling nozzle-and-holder assembly (single-spring holder)

Insert appropriate thrust piece of assembly device KDEP 104[illegible] into drill chuck of bench drill or punch mount of hand press.

Position support plate with inserted nozzle-and-holder assembly under thrust piece such that it presses against the very front of the nozzle, but not against the curved section in the case of hole-type nozzles or against the pintle in the case of pintle nozzles.

Continue: D01/1 Fig.: C26/2



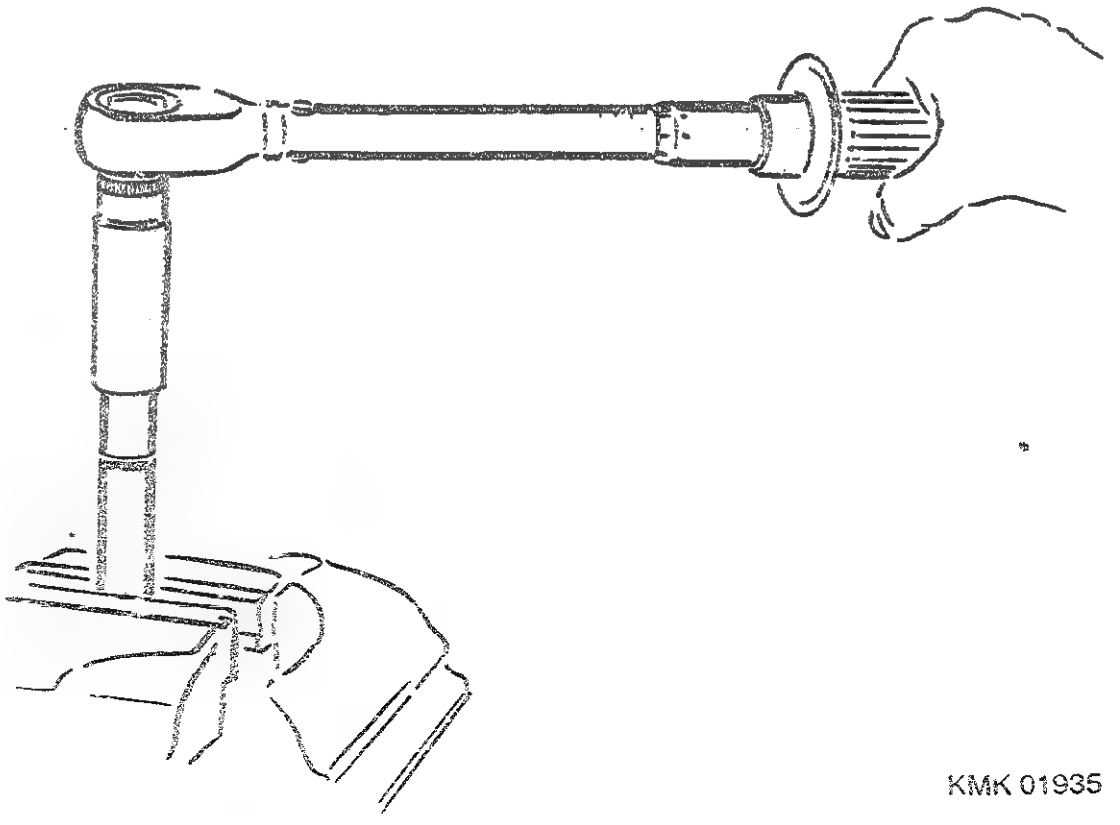
Assembling nozzle-and-holder assembly (single-spring holder)

Relieve tension on nut by pressing on nozzle and screw as far as possible onto supporting device.

Then remove complete nozzle-and-holder assembly from support plate and clamp in vice (use protective jaws!).

Use socket wrench and torque wrench to tighten nozzle tensioning nut to prescribed tightening torque.

Continue: D02/1 Fig.: D01/2



KMK 01935

Assembling dual-spring nozzle-and-holder assembly: KBEL.., KDEL..

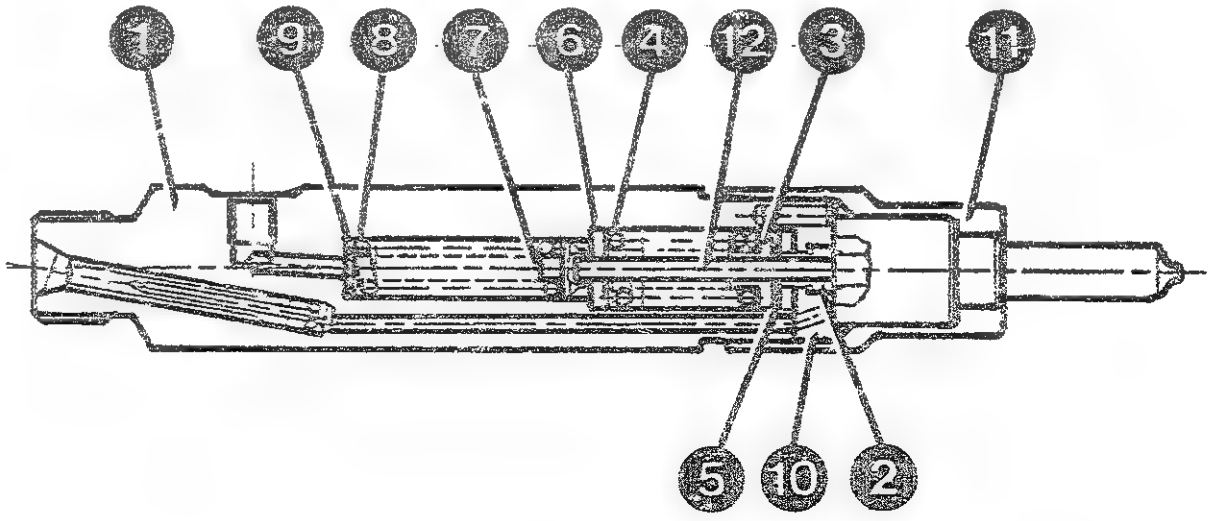
Clamp supporting device in position. Insert first-stage parts into holding device in following order: Shim, helical compression spring, spindle. Insert second-stage parts in following order: Guide disk, helical compression spring, spring seat, shim and stop sleeve. Insert first-stage pushrod. Mount nozzle, screw on tensioning nut and tighten it (pay attention to tightening torque!). The procedure to be employed when fitting the tensioning nut is the same as for single-spring holders.

_Continue: D03/1

Assembling dual-spring nozzle-and-holder assemblies: KBEL.., KDEL..

1 = Supporting device
2 = Stop sleeve
3 = Spring seat
4 = Helical compression spring (stage 2)
5 = Shim
6 = Guide disk
7 = Spindle
8 = Helical compression spring (stage 1)
9 = Shim
10= Intermediate plate
11= Nozzle tensioning nut
12= Pushrod

Continue: D04/1 Fig.: D03/2



KMK 01936

Tightening torques for assembly

Nozzle-holder assembly type:
KBAL(Z)..P..

Screw connection:

Nozzle tensioning nut	30...40 Nm

Continue: D04/2

Tightening torques for assembly (Continued)

Nozzle-holder assembly type:
KDAL(Z)..P..

Screw connection:

Nozzle tensioning nut	30...40 Nm

Continue: D05/1

Tightening torques for assembly
(Continued)

Nozzle-holder assembly type:
KBEL(Z)..P..

Screw connection:

Nozzle tensioning nut	40...50 Nm
Inlet connector in supporting device	30...45 Nm

Continue: D05/2

Tightening torques for assembly
(Continued)

Nozzle-holder assembly type:
KDEL(Z)..P..

Screw connection:

Nozzle tensioning nut	40...50 Nm
Inlet connector in supporting device	30...45 Nm

Continue: D06/1

Tightening torques for assembly
(Continued)

Nozzle-holder assembly type:
KBEL(Z)..S..

Screw connection:

Nozzle tensioning nut	50...70 Nm
Inlet connector in supporting device	30...45 Nm

Continue: D06/2

Tightening torques for assembly
(Continued)

Nozzle-holder assembly type:
KDEL(Z)..S..

Screw connection:

Nozzle tensioning nut	50...70 Nm
Inlet connector in supporting device	30...45 Nm

Continue: D07/1

Tightening torques for assembly (Continued)

Nozzle-holder assembly type: KB(L)..S..

Screw connection:

Nozzle tensioning nut	70...90 Nm
Inlet connector in supporting device	45...65 Nm

Continue: D07/2

Tightening torques for assembly (Continued)

Nozzle-holder assembly type: KBAL(Z)..S..

Screw connection:

Nozzle tensioning nut	70...90 Nm
Inlet connector in supporting device	45...55 Nm *

*) In the case of nozzle-holder assemblies with continuous stem (with no pressed-on head) and inlet connector screwed in on side the tightening torque is 30...45 Nm.

Continue: D08/1

Tightening torques for assembly
(Continued)

Nozzle-holder assembly type:
KDAL(Z)..S..

Screw connection:
Nozzle tensioning nut 70...90 Nm

Inlet connector in
supporting device 45...65 Nm *

*) In the case of nozzle-holder assemblies with continuous stem (with no pressed-on head) and inlet connector screwed in on side the tightening torque is 30...45 Nm.

Continue: D08/2

Tightening torques for assembly
(Continued)

Nozzle-holder assembly type: KB..TA..

Screw connection:
Nozzle tensioning nut 100...140 Nm

Inlet connector in
supporting device 90...110 Nm **

**) In the case of inlet connector with threaded connection M 22x1.5 the tightening torque is 120...140 Nm.

Continue: D09/1

Tightening torques for assembly
(Continued)

Nozzle-holder assembly type: KBF..T ..

Screw connection:	
Nozzle tensioning nut	100...140 Nm
Inlet connector in supporting device	90...110 Nm **

**) In the case of inlet connector with threaded connection M 22x1.5 the tightening torque is 120...140 Nm.

Continue: D09/2

Tightening torques for assembly
(Continued)

Nozzle-holder assembly type: KB..U..

Screw connection:	
nozzle tensioning nut	200...220 Nm
Inlet connector in supporting device	12[illegible]..140 Nm
Threaded connector for leakage connection	50... 60 Nm

Continue: D10/1

Tightening torques for assembly (Continued)

Nozzle-holder assembly type: KBF..U..

Screw connection: nozzle tensioning nut	200.. 220 Nm
Inlet connector in supporting device	120...140 Nm

Continue: E01/1

CHECKING WITH NOZZLE TESTER
0 681 200 502

SAFETY PRECAUTIONS

The following safety precautions must always be heeded when working with the nozzle tester:

Keep hands away from calibrating-oil jet!
The calibrating-oil jet from a nozzle can penetrate deep into the tissue of the human body. The high pressure and the ingress of calibrating oil can destroy the tissue structure and possibly result in blood poisoning.

Continue: E01/2

CHECKING WITH NOZZLE TESTER
0 681 200 502

The nozzle tester is only to be used in conjunction with test-pressure lines bent in accordance with bending specification. There is a danger of line fracture if the test-pressure lines are incorrectly bent.

Calibrating oil and calibrating-oil mist are flammable/explosive. For this reason, naked flames, cigarettes, sparks and the like are prohibited in the vicinity of the nozzle tester.

Continue: E02/2

CHECKING WITH NOZZLE TESTER
0 681 200 502

The nozzle tester must be operated on pure calibrating oil as per ISO 4113. Use is never to be made of gasoline or other readily volatile substances. DANGER OF EXPLOSION!

The nozzle tester is only to be used in conjunction with an extractor such as 0 684 200 702 or 0 684 200 703. The extractor is required to prevent oil mist getting into the ambient atmosphere when nozzles give off spray.

Continue: E02/2

8.1 Checking pintle nozzles

Throttling pintle nozzles, hole-type pintle nozzles and flat-type pintle nozzles
Test criteria:

* Opening pressure
* Seat leakage
* Chatter
* Spray pattern
* Pre-spray of hole-type pintle nozzles

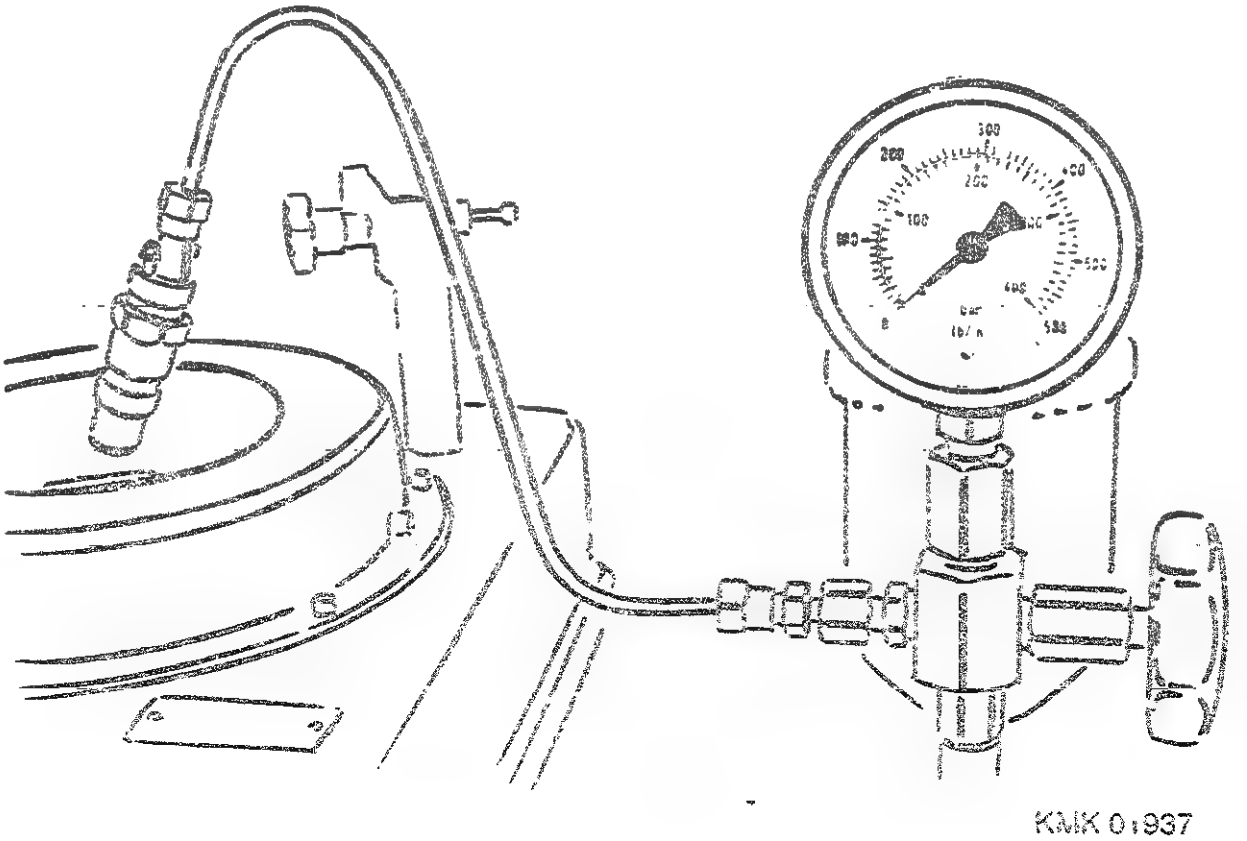
Continue: E03/1

Checking pintle nozzles

Use appropriate connector line to connect up nozzle-and-holder assembly to nozzle tester 0 681 200 502 (EFEP 60 H).

To ensure that the nozzle is not strained, abruptly and rapidly force down hand lever of nozzle tester several times with pressure gauge switched off.

Continue: E04/1 Fig.: E03/2



KMK 0:937

Checking pintle nozzles

8.1.1 Checking opening pressure

Open shutoff valve on pressure gauge approximately 1/2 turn.
Slowly press down hand lever of nozzle tester. This causes the pressure indicated on the gauge to increase.
Observe the pressure at which the pointer of the pressure gauge comes to a halt (no nozzle chatter) or when the pressure suddenly drops off (nozzle chatters).
The maximum pressure attained is the opening pressure.

Continue: E04/2

Checking pintle nozzles

The opening pressure prescribed for a nozzle-and-holder assembly is often marked in the nozzle-holder body.

Checking opening pressure

If this is not the case, the value must be determined from the corresponding engine-manufacturer's documentation or from the equipment microcard (AK).

The adjustment tolerance is generally + 8 bar.

Continue: E05/1

Checking pintle nozzles

The following values apply to the GMPT (GMC/Chevrolet) nozzle and holder assemblies 0 432 217 081, 0 432 217 092 and 0 432 217 104:

On checking	:	Min. 105 bar
New setting	:	125 + 10 bar

Continue: E06/1

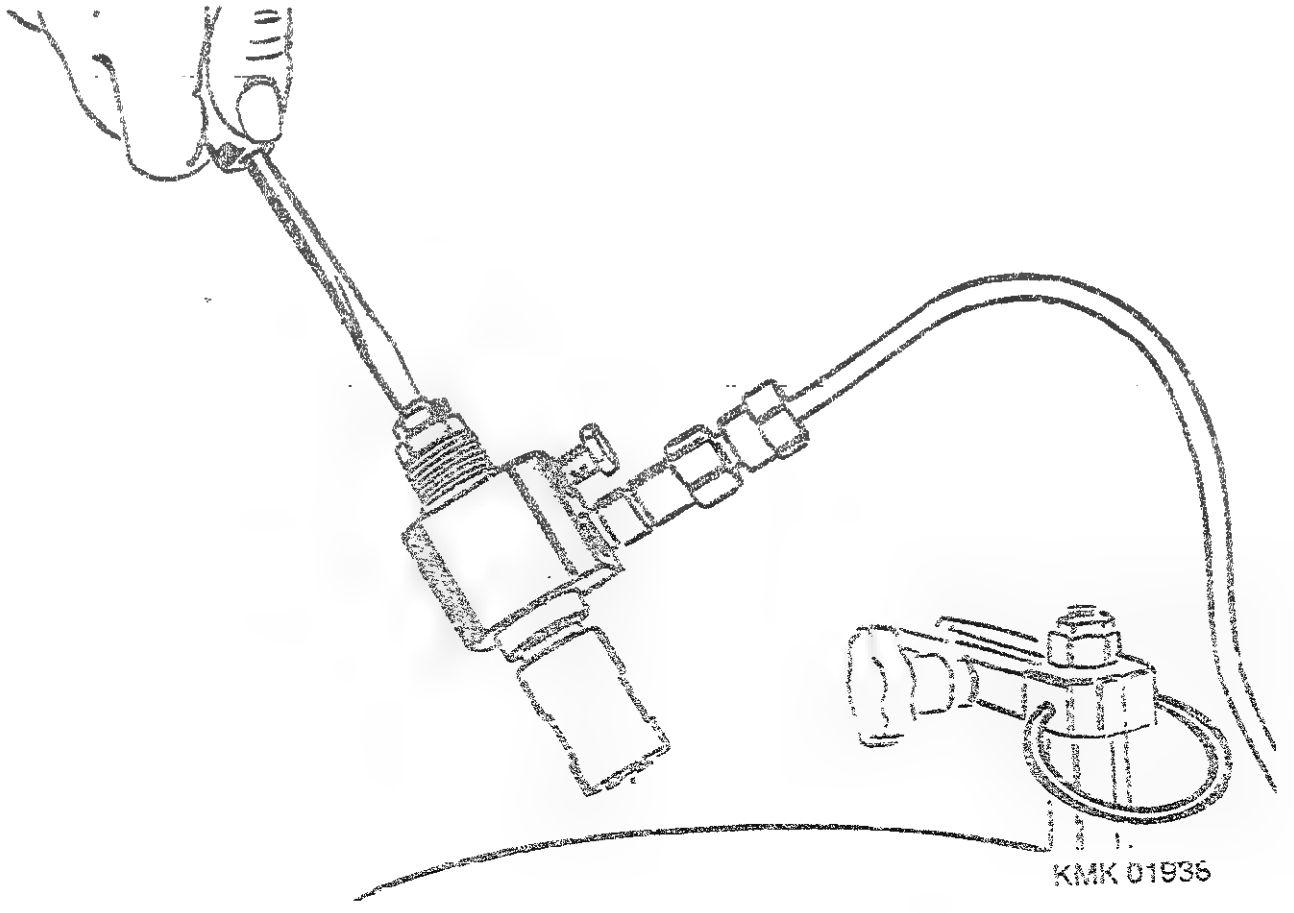
5.1.2 Adjusting opening pressure

Unscrew cap.
Loosen lock nut and turn adjusting screw until prescribed opening pressure is obtained.

Turning in the screw produces a higher opening pressure.

Once the required opening pressure has been obtained, tighten lock nut to prescribed tightening torque and screw on cap.

Continue: E07/1 Fig.: E06/2



Checking pintle nozzles

5.1.3 Tightening torques

Screw connection	Nozzle-holder assembly type KB(L)..S... Nm	KB..TA.. Nm	KBF..T.. Nm
Lock nut (for adjusting screw)	5...15	10...20	5...10
Union nut (cap)	40...60	40...60	40...60

Continue: E07/2

Checking pintle nozzles

Tightening torques (continued)

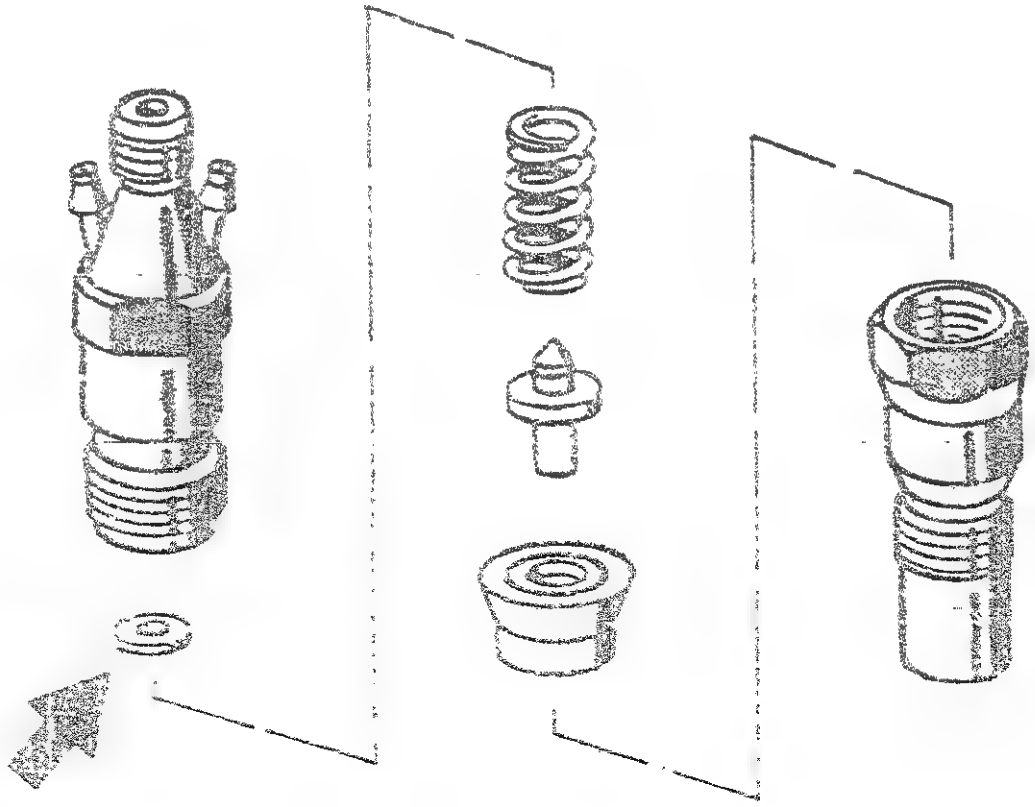
Screw connection	Nozzle-holder assembly type KB..U.. Nm	KBF..U.. Nm
Lock nut (for adjusting screw)	30...40	10...20
Union nut (cap)	50...70	50...70

Continue: E03/2

2.1.4 Adjusting opening pressure (KCA..S..), (KCE..S..)

Unscrew complete nozzle-and-holder assembly from pressure line of nozzle tester and clamp in vice. (Use protective jaws!).
Unscrew nozzle tensioning nut.
Remove and set down nozzle.
Remove all remaining parts of nozzle-holder assembly. The opening pressure is set by selecting the required shim (see picture, arrow).
A thicker shim produces a higher opening pressure.

Continue: E09/1 Fig.: E08/2

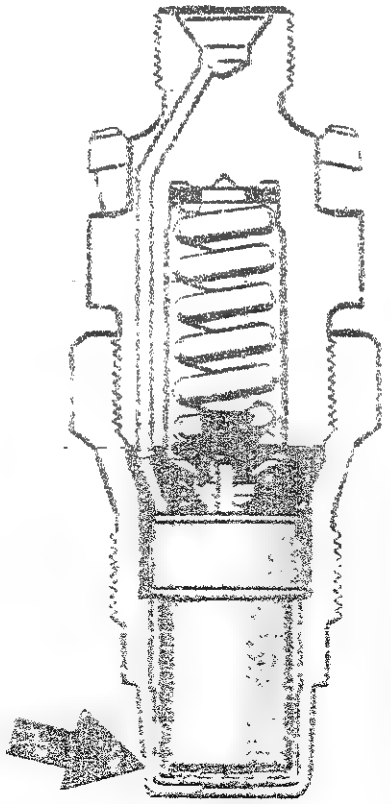


K.MK 01939

Checking bubble nozzles

Once the prescribed opening pressure has been obtained, a new thermal-insulation washer is to be installed in the correct position in the nozzle tensioning nut in the case of nozzle-and-holder assemblies with integrated thermal insulation (see picture, arrow).

Continue: E10/1 Fig.: E09/2



Checking pintle nozzles

S.1.5 Seat leak test

Shutoff valve on pressure gauge of nozzle tester remains open approx. one quarter of a turn.
To ensure reliable assessment of leakage, dry off bottom part of nozzle and nozzle-holder assembly (blow dry with air).
Slowly press down hand lever of nozzle tester until pressure-gauge reading is 20 bar below the opening pressure previously read.

Continue: E10/2

Checking pintle nozzles

The nozzle is leakproof if the time between two droplets is at least 10 seconds. Moisture at the mouth of the nozzle is permitted.

(If there are no droplets after 60 seconds, the seat leakage is likewise ok).

Continue: E11/1

Checking pintle nozzles

Leakage oil must not be clicked to falsify the test result If a droplet does, however, form, dismantle nozzle-and-holder assembly again and clean parts of nozzle-holder assembly and nozzle to eliminate leak. If the repeat test again reveals nozzle leakage, replace nozzle with a new one. Reworking of parts of the nozzle is not permitted.

Continue: E11/2

Checking pintle nozzles

In the case of nozzle-and-holder assemblies with integrated thermal protection, renew corresponding thermal-insulation washer between nozzle and nozzle tensioning nut whenever disassembly is performed.

Continue: E10/1

Checking pintle nozzles

2.1.1 Chatter test Assessment of spray pattern

General:
When assessing nozzles, a distinction is to be made between new and used nozzles.

Perform chatter and spray test consecutively!
Switch off pressure gauge of nozzle tester by closing shutoff valve.
This is done to protect the pressure gauge.

Continue: E12/2

Checking pintle nozzles

New nozzles:

The chatter test makes it possible to audibly check the freedom of movement of the nozzle needle in the nozzle body.

If a nozzle does not chatter despite cleaning, it is to be replaced with a new one.
The shape of the spray is of no significance for the chatter test.
A spray pattern corresponding to the specification is generally only found with new nozzles.

Continue: E12/3

Checking pintle nozzles

Used nozzles:

The chatter behavior of the nozzle is impaired by wear in the seat area. The nozzle must chatter audibly and/or produce a well-atomized spray when the lever is rapidly operated. In the case of used nozzles, the spray pattern may deviate from the ideal shape with a new nozzle.

This does not however mean that impairment of the engine running behavior can always be concluded.

Continue: E13/2

Chatter test, assessment of spray pattern

The spray pattern of such spray nozzles can however be appreciably improved by means of suitable cleaning measures in an ultrasonic cleaning unit.

Continue: E14/1

Checking pintle nozzles

Pintle nozzles with an unchecking effect
(New nozzles: DN .2.., DN..5.., DN .7..

Chatter test:
Such pintle nozzles feature recoil-
audible chatter over the entire
actuatable lever-speed range.
Lowest test speed: 1 downward motion
of hand lever per second.
There is no significance to small
interim ranges with no chatter;
the shape of the spray is likewise of
no significance for the chatter test.

Continue: E14/2

Checking pintle nozzles

Spray pattern:
Even, well-atomized spray irrespective
of test speed (pay attention to spray-
dispersal angle).

Continue: E14/4

Checking pintle nozzles

Pintle nozzles with throttling effect including hole-type pintle nozzle, not including flat-type pintle nozzle and version for GMT (GMC-Chevrolet)
DN 0 SD 248 - 0 434 250 105 or
DN 0 SD 253 - 0 434 250 113

DN..RD.. DN..S.., DN..TD..

Chatter test:
The special design features of this nozzle are such that the chatter is very quiet.

Continue: E15/2

Checking pintle nozzles

A chatter test is only possible in this case with between 1 and 2 downward movements of the hand lever per second.

The chatter stops if the [illegible] speed is increased.
The calibrating oil then emerges from the nozzle with a hissing noise.
The nozzle does not chatter loudly until the movement of the hand lever is rapid and abrupt (approx. 3... downward movements per second)

Continue: E15/1

Pintle type nozzles

Spray pattern (needle and pintle
nozzles)

It is only possible to assess the state
of the spray with regard to correct
performance within the nozzle holder.
There must be a closed, well-atomized
spray.

Continue: E16/2

Checking pintle nozzles

Pintle nozzles with throttling effect;
version for GMPT (GMC/Chevrolet)
DN 0 SD 158 - 0 434 250 106 or
DN 0 SD 253 - 0 434 250 111
in the nozzle-and-holder assemblies
0 432 217 031, 0 432 217 092 and
0 432 217 104

Chatter test:

Perform chatter test as follows on
account of the special design features:

Continue: E16/3

Checking pintle nozzles

Slowly press down hand lever of nozzle tester and establish whether chatter can be heard.

If no chatter can be heard, move hand lever more and more quickly until nozzle chatters.

If the nozzle cannot be made to chatter, first unscrew nozzle tensioning nut, thoroughly clean seat surface of nozzle thermal-insulation washer and nozzle tensioning nut, and re-assemble fitted with a new thermal-insulation washer.

Continue: E17/2

Checking pintle nozzles

If chatter is still not achieved, replace nozzle.
Spray test: (Applies only to new nozzles)
Rapidly and abruptly push down hand lever on nozzle tester.
There must be a closed, well-atomized fuel spray.

Continue: E17/3

Checking pintle nozzles

Pintle nozzle with throttling effect -
"Flat-pintle nozzle 0.4 mm".

These nozzles feature a ground area on
one side at the pintle.
The surface thus produced results in an
oval cavity.

Chatter test:

This nozzle chatters very quietly on
account of the special design features.

Continue: E13/2

Checking pintle nozzles

A chatter test is only possible in
this case with between 1 and 2
downward movements of the hand lever
per second.
Increasing the test speed causes the
chatter to stop.

The calibrating oil then emerges from
the nozzle with a hissing noise.

This nozzle only whistles loudly when
the movement of the hand lever is
rapid and regular.

Continue: E13/1

Checking pintle nozzles

Spray pattern (pintle only in key nozzle).

Until the lock whistling tone starts, the spray may be streaky and non-atomized.

A small spray and the forerun of streaks have no significance in this range.

To assess the shape of the spray, the hand lever is to be pressed down rapidly and abruptly.

The spray must then be thoroughly atomized.

Continue: E19/2

Checking pintle nozzles

The cross-section of the spray is oval in shape and is larger than the spray of a throttling pintle nozzle with no surface at the pintle.

Continue: E19/2

Checking pintle nozzles

Pintle nozzle with vibrating effect -
Pintle nozzle: DN..SD.. , DN..SD..

The bottom of these nozzles is specially shaped and there is an additional hole through which the pre-spray emerges.

Chatter test:

The chatter with this nozzle is very quiet on account of the special design features. A chatter test is only possible in this case with between 1 and 2 downward movements of the hand lever per second.

Continue: E20/2

Checking pintle nozzles

Increasing the test speed causes the chatter to stop.

The calibrating oil then emerges from the nozzle with a hissing noise.

This nozzle only whistles loudly when the movement of the hand lever is rapid and abrupt.

Spray pattern: (Applies only to new nozzles)

[illegible] pintle nozzles

At low test speed the majority of the amount delivered must be thoroughly atomized and emerge through the pre-spray hole on the side without any pronounced streaking.

Assessment of the main spray is only possible with rapid movement of the hand lever (approx. 4...6 downward movements per second).

There must be a closed, well-atomized spray.

Continue: E22/1

[illegible] Checking hole-type nozzles and pintle nozzles

Test criteria:

* Opening pressure
* Seat leakage
* Chatter
* Spray pattern

Use is to be made for test purposes of pure calibrating oil as per ISO 4113 or clean diesel fuel.

Check nozzles with appropriate nozzle-holder assemblies.

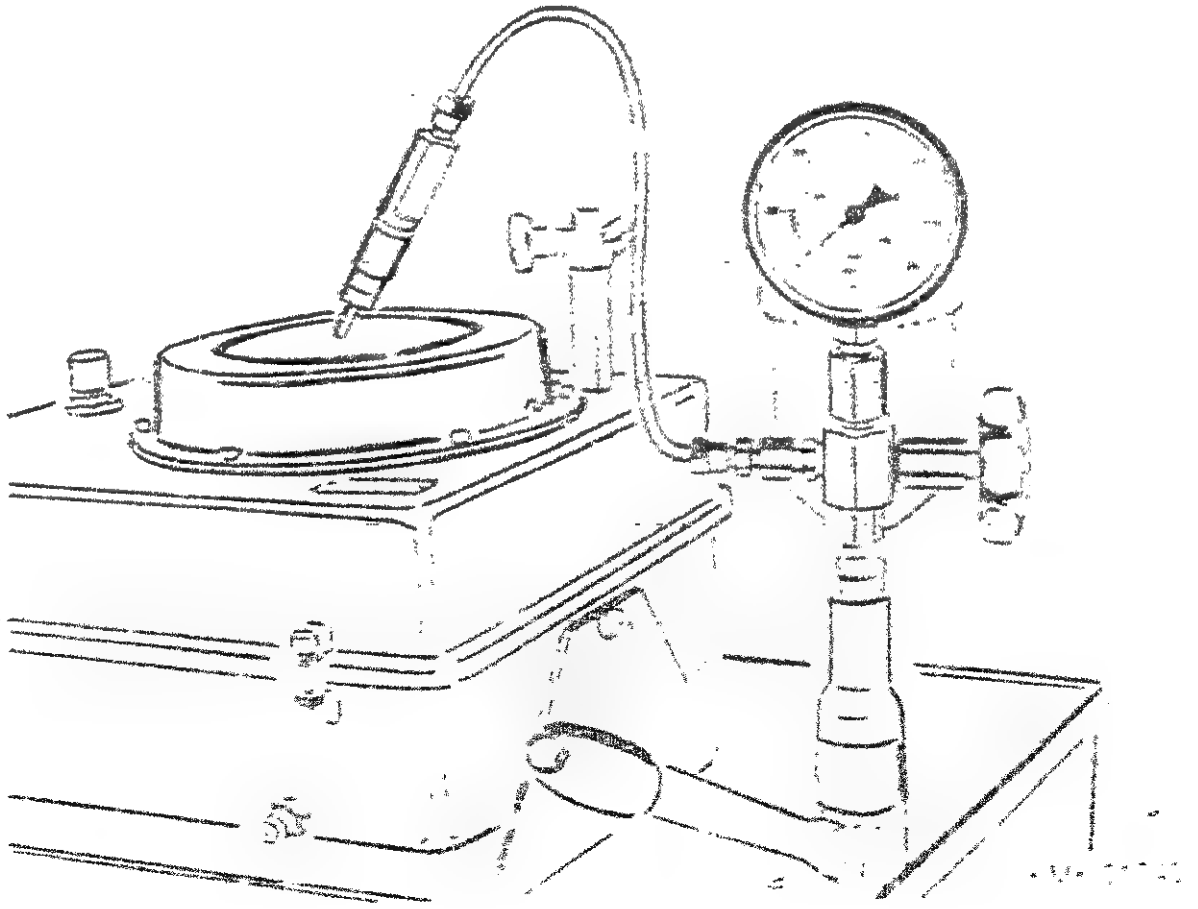
Continue: E23/1

Checking hole-type nozzles and seat-hole nozzles

Use appropriate test-pressure line to connect up nozzle-and-holder assembly to nozzle tester 0 681 200 502 (EFEP 60 H).

To ensure that the nozzle is not subjected to strain, force down hand lever of nozzle tester several times with pressure gauge switched off.

Continue: E24/1 Fig.: E23/2



Checking hole-type nozzles and
sect-hole nozzles

Attention is to be paid to the
following safety precautions when
working on the nozzle tester:

Keep hands away from calibrating-oil
jet!

The calibrating-oil jet from a nozzle
can penetrate deep into the tissue of
the human body.

The high pressure and the ingress of
calibrating oil can destroy the tissue
structure and possibly result in blood
poisoning.

Continue: E25/1

Checking hole-type nozzles and
hole-type nozzles with seat

8.2.1 Checking opening pressure

Open shut-off valve at pressure gauge approx. half a turn.
Slowly press down hand lever of nozzle tester. The pressure indicated on the pressure gauge increases.
Note the pressure at which the pointer of the pressure gauge comes to a halt (no nozzle chatter) or the pressure at which there is a sudden drop in pressure (nozzle chatter).
The maximum pressure attained is the opening pressure.

Continue: E25/2

Checking hole-type and valve covered orifice nozzles

In some cases the envisaged opening pressure for the nozzle-and-holder assembly is stamped on the nozzle-holder body.

If this is not the case, the value is to be determined from the appropriate documentation of the engine manufacturer or from the microcards via Equipment (AK).

Generally speaking the adjustment tolerance is ± 2 bar

Continue: E25/3

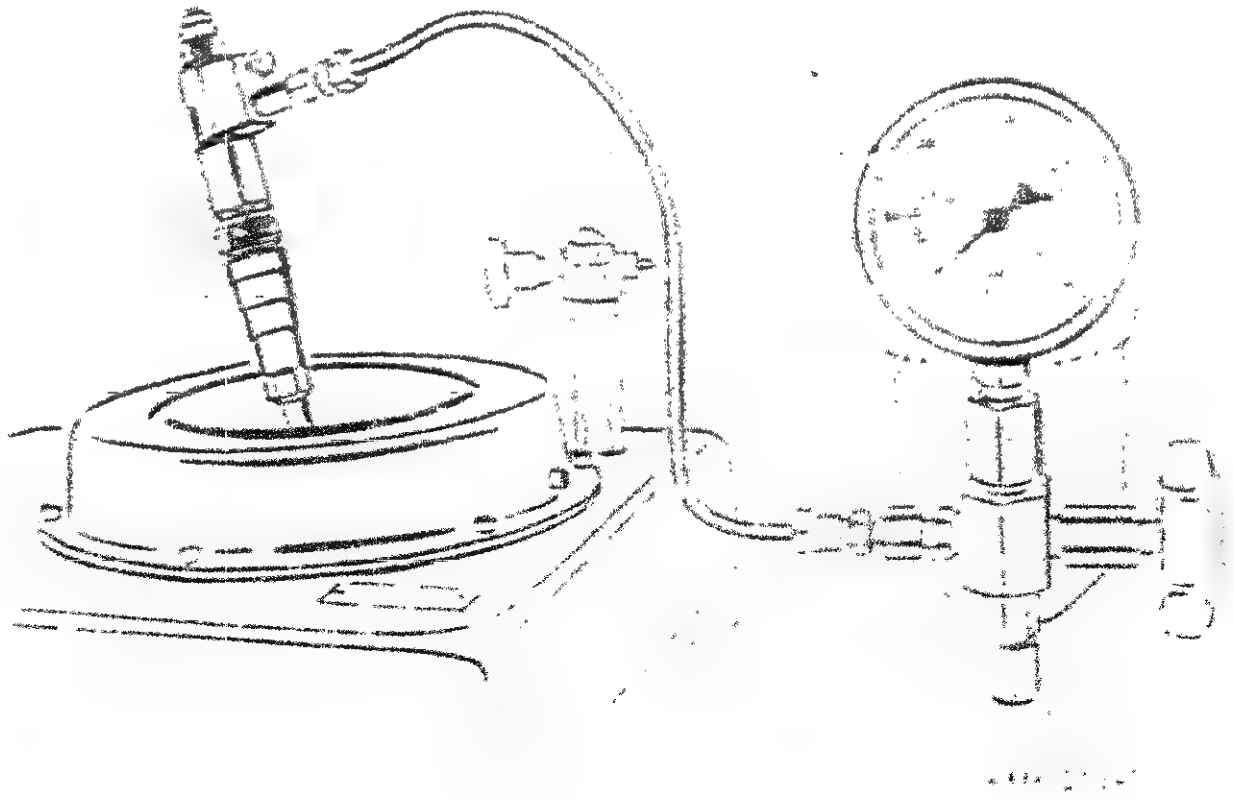
Checking hole-type nozzles and
pole-type nozzles with test

2.2 Adjusting opening pressure
(KB(L) .3 .), (KB..TA..), (KEF..T

Unscrew cap.
Loosen lock nut and turn adjusting
screw until prescribed opening
pressure is attained.

Screwing in the screw produces a
higher opening pressure.
Once the required opening pressure
has been obtained, tighten lock nut
to prescribed opening torque and
screw on cap.

Continue. E27/1 Fig.: E26/1



Checking hole-type nozzles and
hole-type nozzles with seat

8.2.3 Tightening torques

Union	Nozzle holder type KB(L)..S.. Nm	KB..TA.. Nm	KBF..T.. Nm
Lock nut (for adjusting screw)	5...15	10...20	5...10
Cap nut (cap)	40...60	40...60	40...60

Continue: E27/2

Checking hole-type nozzles and
seat-hole nozzles

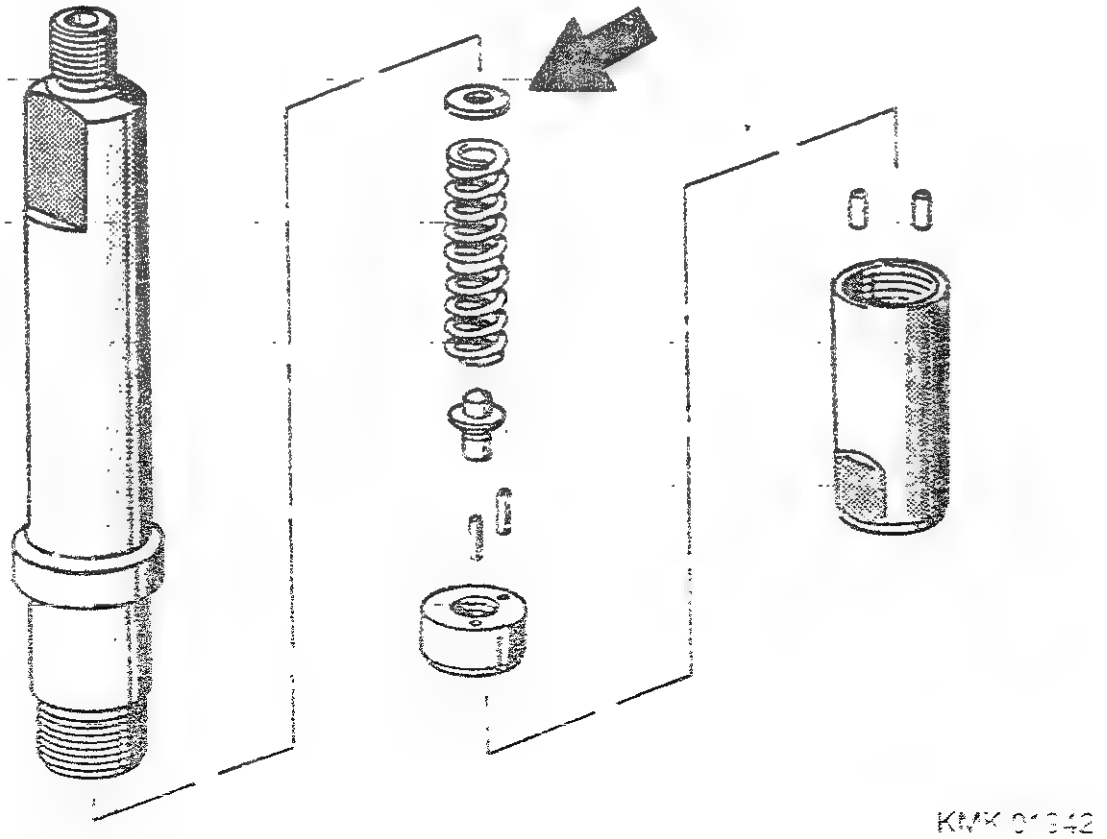
Tightening torques (continued)

Screw connection	Nozzle-holder assembly type KB..U.. Nm	KBF..U.. Nm
Lock nut (for adjusting screw)	30...40	10...20
Union nut (cap)	50...70	50...70

Continue: E28/1

8.2.4 Adjusting opening pressure
(KDAL(Z)..), KDEL(Z)..)
(1-spring holder)
Unscrew complete nozzle holder assembly from delivery tubing of nozzle tester and clamp in vice.
Use protective jaws!
Unscrew nozzle clamping nut.
Remove nozzle and set it down.
Remove all remaining parts of nozzle holder. The opening pressure is adjusted by selecting the required shim (see picture, arrow). A thicker shim produces a higher opening pressure.

Continue: F01/1 Fig.: E28/2



KMK 01342

Checking hole-type nozzles and
seat-hole nozzles

Then re-assemble nozzle-and-holder
assembly as prescribed and check on
nozzle tester.

Continue: F01/2

Checking hole-type nozzles and
seat-hole nozzles

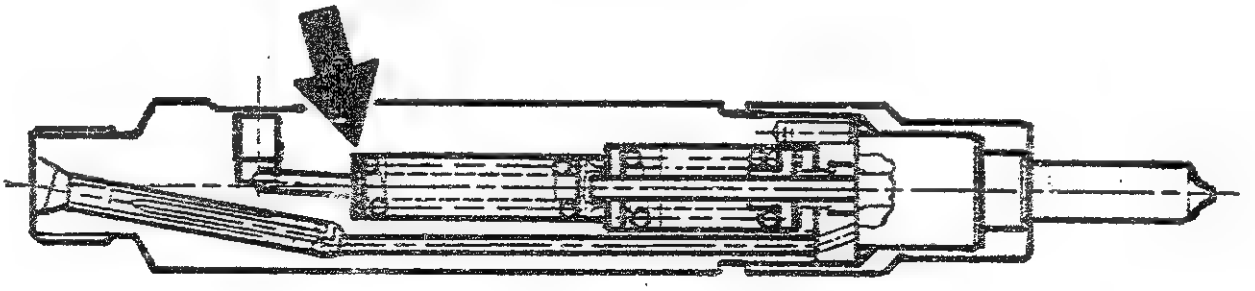
Adjusting opening pressure
(KBEL..P..), (KDEL..P..)
(dual-spring holder)
Unscrew complete nozzle-and-holder
assembly from pressure line of nozzle
tester and clamp in position in vice.
Make use of protective jaws!
Unscrew nozzle tensioning nut.
Remove and set down nozzle.
Remove 2nd-stage parts and store
complete on mandrel. Remove
first-stage parts.

Continue: F02/1

Checking hole-type nozzles and seat-hole nozzles

The opening pressure is adjusted by selecting the required shim (see picture, arrow). A thicker shim produces a higher opening pressure.

Continue: F03/1 Fig.: F02/2



KMK 01943

Checking hole-type nozzles and
hole-type nozzles with seat

8.2.5 Seat leak test

Shut-off valve at pressure gauge of nozzle tester remains open approximately one quarter of a turn.
To ensure reliable leakage assessment, dry bottom part of nozzle and nozzle holder (blow dry with air).
Slowly press down hand lever of nozzle tester until pressure gauge indicates 20 bar below opening pressure previously read off.

Continue: F03/2

Checking hole-type nozzles and
seat-hole nozzles

The nozzle is leakproof if the time between two droplets is at least 10 seconds. Moisture at the mouth of the nozzle is permitted.

(If there are no droplets after 60 seconds, the seat leakage is likewise ok).

Continue: F04/1

Checking hole-type nozzles and
seat-hole nozzles

If a droplet does drip off, dismantle nozzle-and-holder assembly again and clean parts of nozzle-holder assembly and nozzle to eliminate leak.

If the repeat test again reveals nozzle leakage, the nozzle is to be replaced with a new one.

Reworking of parts of the nozzle is not permitted.

Continue: F04/2

Checking hole-type nozzles and
hole-type nozzles with seat

8.2.6 Chatter test, assessment of spray pattern

General:
A distinction is to be made between new and used nozzles as regards assessment.

Consecutively perform chatter and spray test!
Switch off pressure gauge of nozzle tester by closing shut-off valve.
This is done to prevent pressure gauge damage.

Continue: F05/1

Checking hole-type nozzles and seat-hole nozzles

New nozzles:

The chatter test makes it possible to audibly check the freedom of movement of the nozzle needle in the nozzle body.
The chatter of new nozzles is a function of the nozzle dimensions: Seat, guide and blind hole/grinding diameter at end of needle for DLL(A).. nozzles; seat guide and hole-circle diameter with DSLA nozzles.
This results in the formation of chatter characteristic groups which reflect the chatter behavior of the nozzles.

Continue: F05/2

Checking hole-type nozzles and seat-hole nozzles

If a nozzle does not chatter despite cleaning, it is to be replaced with a new one.
The shape of the spray is of no significance for the chatter test.

A spray pattern corresponding to the specification is generally only found with new nozzles.

It is not possible to assess the spray pattern of dual-spring assemblies with the nozzle tester.

Continue: F06/1

Checking hole-type nozzles and seat-hole nozzles

Used nozzles:

Wear in the seat area impairs the chatter behavior of the nozzle. For this reason, the chatter characteristic groups are not to be used here.
If the lever is operated quickly, the nozzle must be heard to chatter (possibly with loud whistling tone) and the spray must be thoroughly atomized.

Continue: F06/2

Checking hole-type nozzles and seat-hole nozzles

The spray pattern with used nozzles may deviate from the ideal shape of a new nozzle.

This does not however always mean that poor engine running behavior can be concluded.

The spray pattern of such nozzles can, however, be noticeably improved by way of suitable cleaning measures.

Continue: F07/1

Checking hole-type nozzles and seat-hole nozzles

The microcard WP-430 gives an indication of the chatter characteristic group according to which the corresponding nozzle is to be checked.

The diagrams below are intended to outline the movements of the nozzle needles as they chatter as a function of the speed of movement of the nozzle-tester lever in the individual characteristic groups.

Continue: F07/2

Checking hole-type nozzles and seat-hole nozzles

CHATTER CHARACTERISTIC GROUP I

Chatter:
Good chatter in entire lever-speed range:
Lowest test speed: One downward movement per second.
Spray pattern:
Given low test speed, dispersed spray with coarse atomization. The spray becomes full and finaly atomized with increasing lever speed.

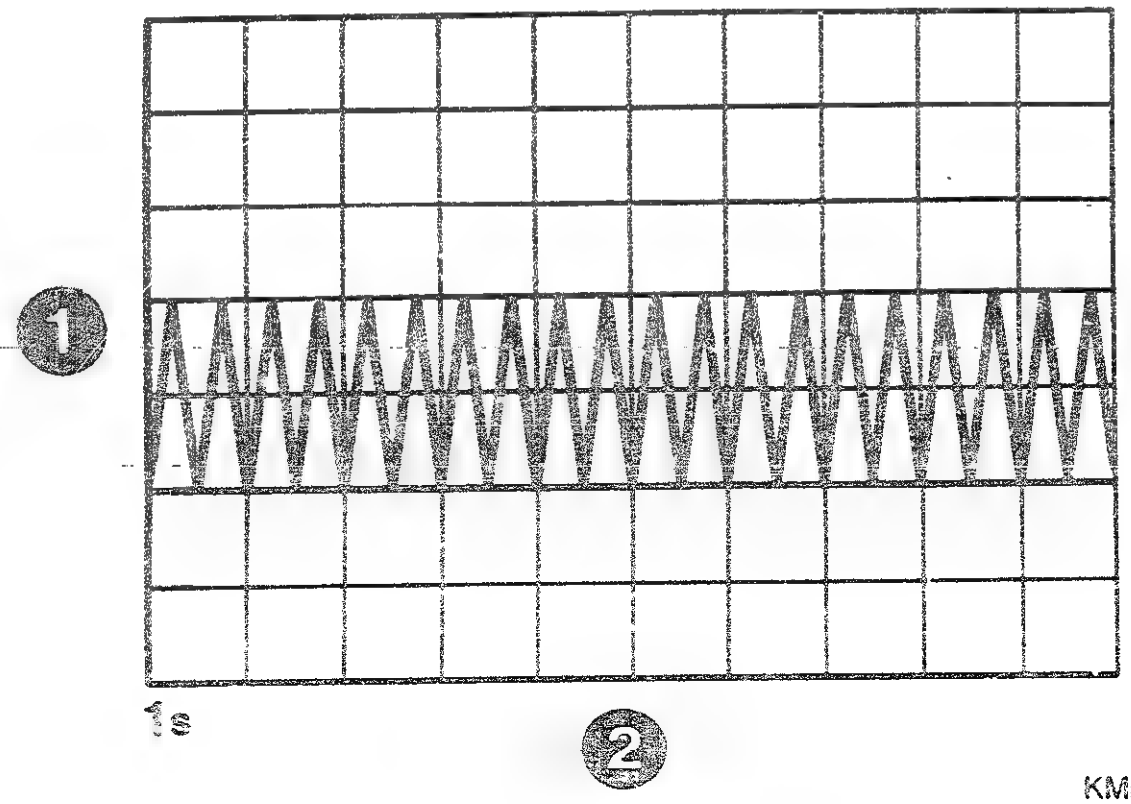
Continue: F08/1

Checking hole-type nozzles and seat-hole nozzles

Important: With some DLL(A).. nozzle types the calibrating oil emerging may be unevenly distributed over the holes. This always applies to DSLA nozzles.

1 = Needle stroke
2 = Time for 1 downward movement of hand lever (increasing test speed)

Continue: F09/1 Fig.: F08/2



KMK 01944

Checking hole-type nozzles and
seat-hole nozzles

CHATTER CHARACTERISTIC GROUP "C"

Chatter behavior: Good chatter at high and low lever speed. There may be small interim ranges with no chatter.
Spray pattern:
Given low test speed, dispersed spray with coarse atomization. Non-atomized cord-like spray in no-chatter range. The spray becomes full and finely atomized with increasing lever speed.

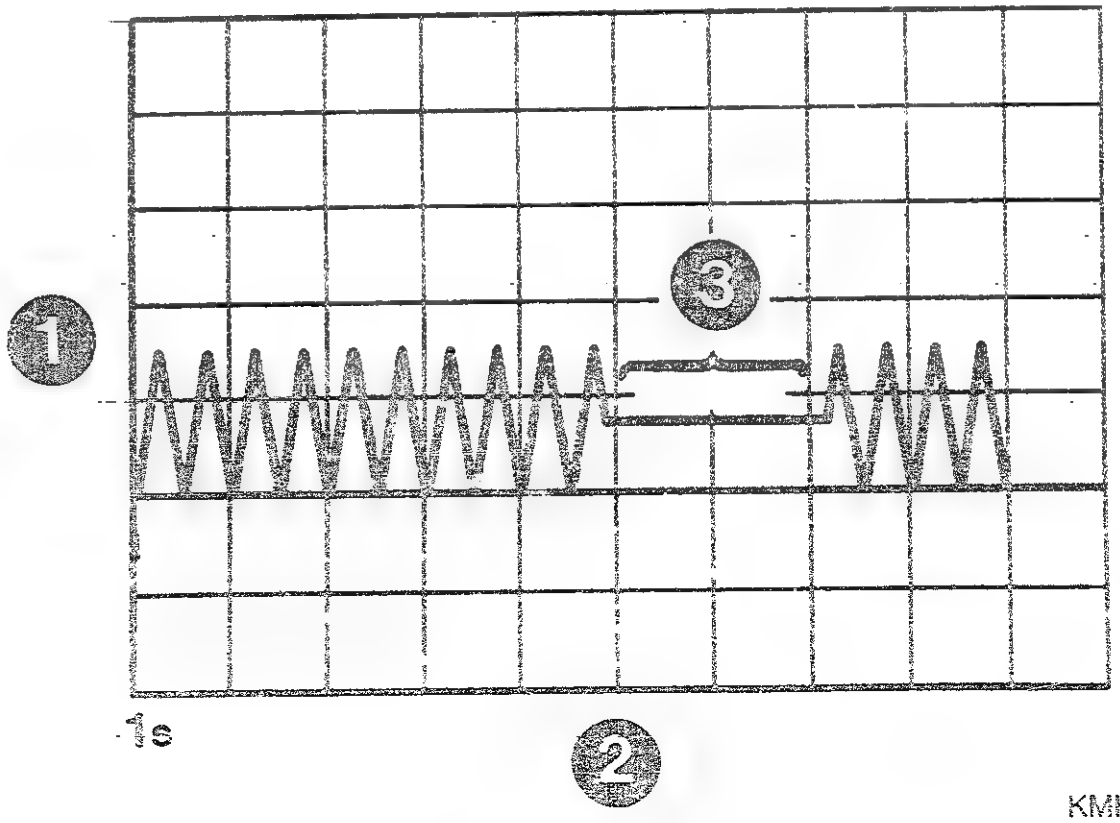
Continue: F10/1

Checking hole-type nozzles and seat-hole nozzles

Important: With some DLL(A).. nozzle types the calibrating oil emerging may be unevenly distributed over the holes. This always applies to DSLA nozzles.

1 = Needle stroke
2 = Time for 1 downward movement of hand lever (increasing test speed)
3 = No chatter

Continue: F11/1 Fig.: F10/2



KMK 01945

Checking hole-type nozzles and
seat-hole nozzles

CHATTER CHARACTERISTIC GROUP III

Chatter behavior:
Chatter only with slow and fast lever operation; there is a broad no-chatter area between the two.
Spray pattern:
Non-atomized cord-like spray up to high test speed.
The spray then becomes full and finaly atomized.

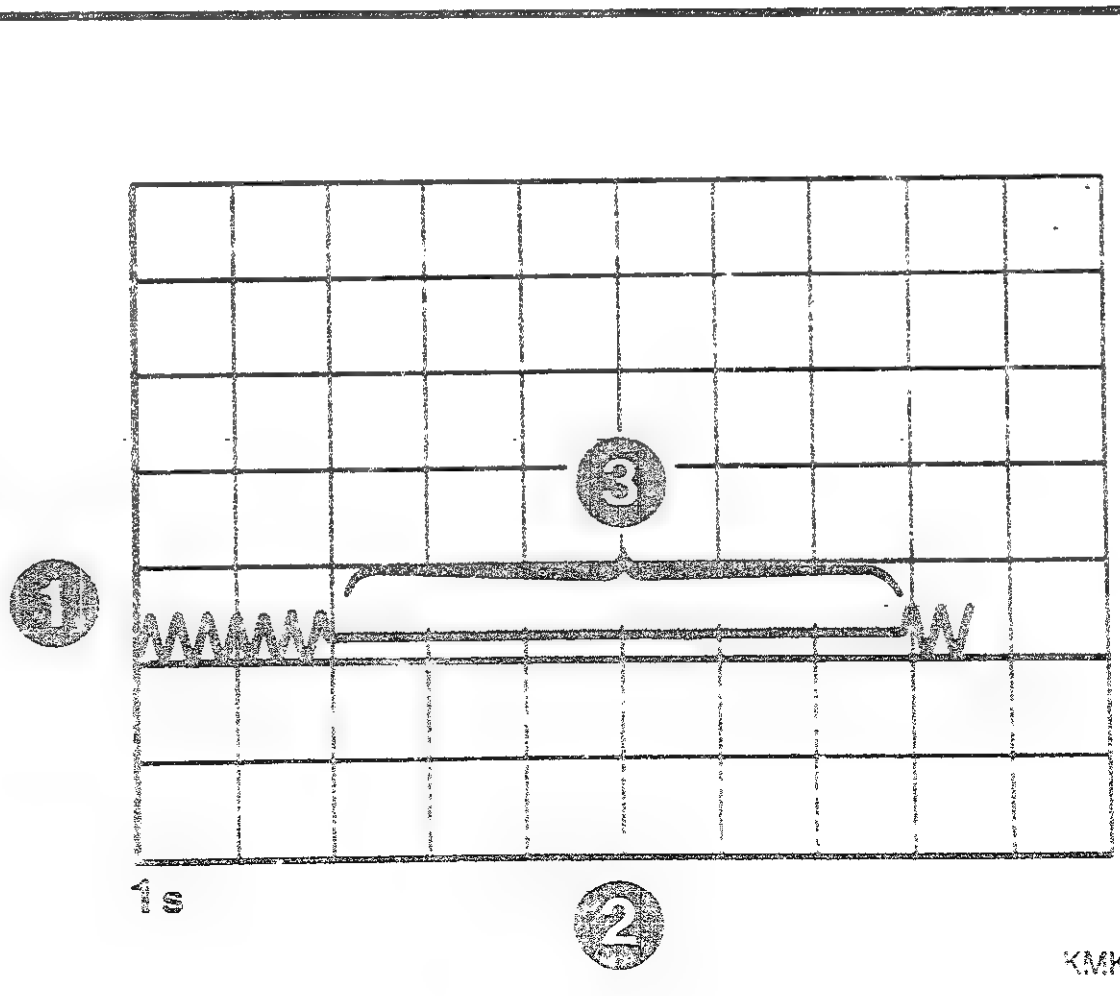
Continue: F12/1

Checking hole-type nozzles and seat-hole nozzles

Important: With some DLL(A).. nozzle types the calibrating oil emerging may be unevenly distributed over the holes. This always applies to DSLA nozzles.

1 = Needle stroke
2 = Time for 1 downward movement of hand lever (increasing test speed)
3 = Does not chatter and drips

Continue: G01/1 Fig.: F12/2



KMK 01946

CHECKING WITH NOZZLE TESTER
0 684 200 704

SAFETY PRECAUTIONS

The following safety precautions must always be heeded when working with the nozzle tester:

Keep hands away from calibrating-oil jet!
The calibrating-oil jet from a nozzle can penetrate deep into the tissue of the human body. The high pressure and the ingress of calibrating oil can destroy the tissue structure and possibly result in blood poisoning.

Continue: G01/2

CHECKING WITH NOZZLE TESTER
0 684 200 704

The nozzle tester is only to be used in conjunction with test-pressure lines bent in accordance with bending specification. There is a danger of line fracture if the test-pressure lines are incorrectly bent.

Calibrating oil and calibrating-oil mist are flammable/explosive. For this reason, naked flames, cigarettes, sparks and the like are prohibited in the vicinity of the nozzle tester.

Continue: G02/1

CHECKING WITH NOZZLE TESTER 0 684 200 704

The nozzle tester must be operated on pure calibrating oil as per ISO 4113. Use is never to be made of gasoline or other readily volatile substances. DANGER OF EXPLOSION!

The nozzle tester is only to be used in conjunction with an extractor such as 0 684 200 702 or 0 684 200 703. The extractor is required to prevent oil mist getting into the ambient atmosphere when nozzles give off spray.

Continue: G03/1

CHECKING WITH NOZZLE TESTER
0 684 200 704

9.1 Checking pintle nozzles

Throttling pintle nozzles, hole-type pintle nozzles and flat-type pintle nozzles.

Test criteria:

* Opening pressure
* Seat leakage
* Assembly leakage
* Chatter
* Spray pattern
* Pre-spray of hole-type pintle nozzle

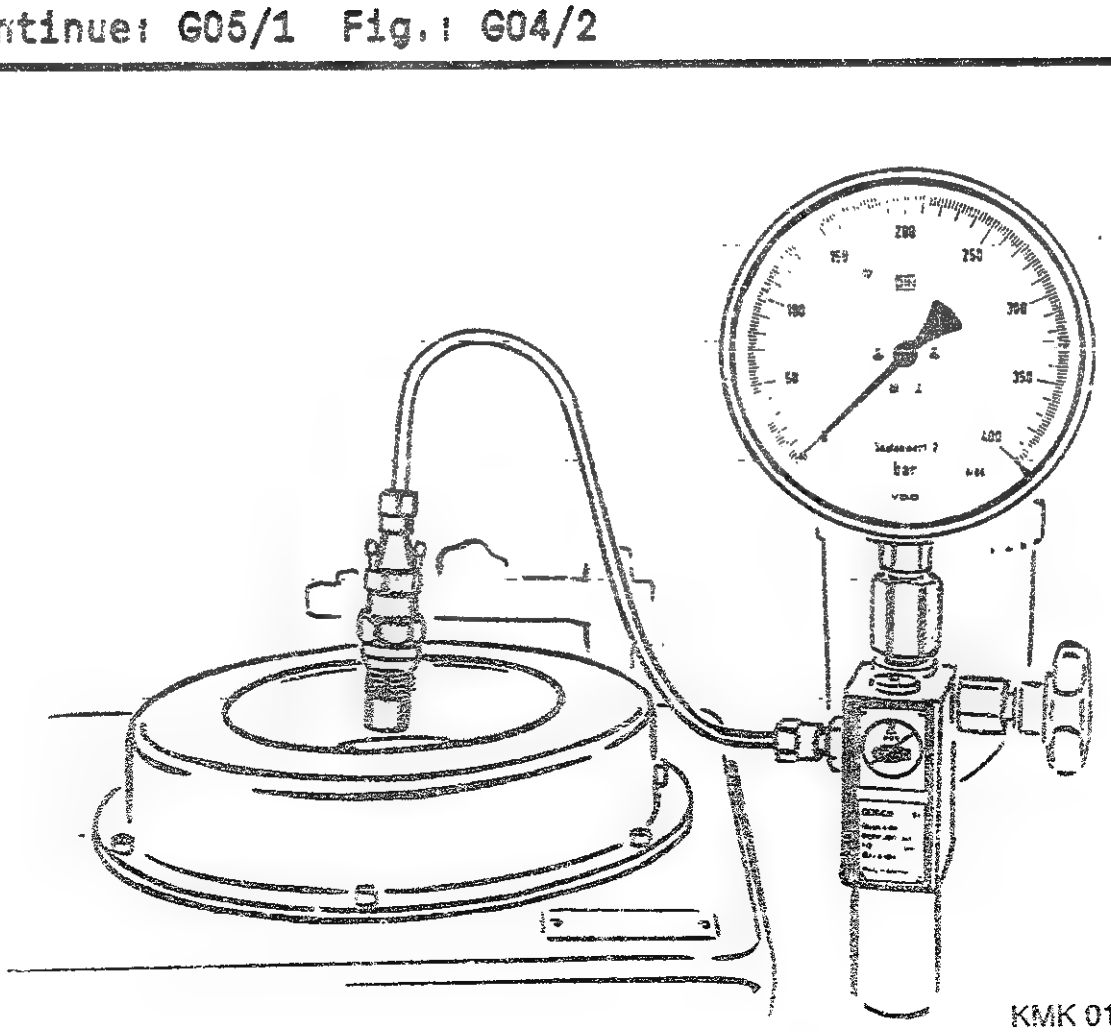
Continue: G04/1

Checking pintle nozzles

Use appropriate pressure line to connect up nozzle-and-holder assembly to nozzle tester 0 684 200 704 (EPS 100).

To ensure that the nozzle is not subjected to strain, rapidly and abruptly force down hand lever of nozzle tester several times with pressure gauge switched off.

Continue: G05/1 Fig.: G04/2



KMK 01947

Checking pintle nozzles

9.1.1 Checking opening pressure

Open shutoff valve ; pressure gauge approximately 1/2 t. n.
Slowly press down hand lever of nozzle tester. This causes the pressure indicated on the gauge to increase.
Observe the pressure at which the pointer of the pressure gauge comes to a halt (no nozzle chatter) or when the pressure suddenly drops off (nozzle chatters).
The maximum pressure attained is the opening pressure.

Continue: G05/2

Checking pintle nozzles

The opening pressure prescribed for a nozzle-and-holder assembly is often marked in the nozzle-holder body.

Checking opening pressure

If this is not the case, the value must be determined from the corresponding engine-manufacturer's documentation or from the equipment microcard (AK).

The adjustment tolerance is generally + 8 bar.

Continue: G06/1

Checking pintle nozzles

The following values apply to the GMPT (GMC/Chevrolet) nozzle-and-holder assemblies 0 432 217 081, 0 432 217 092 and 0 432 217 104:

On checking	:	Min. 105 bar
New setting	:	125 + 10 bar

Continue: G07/1

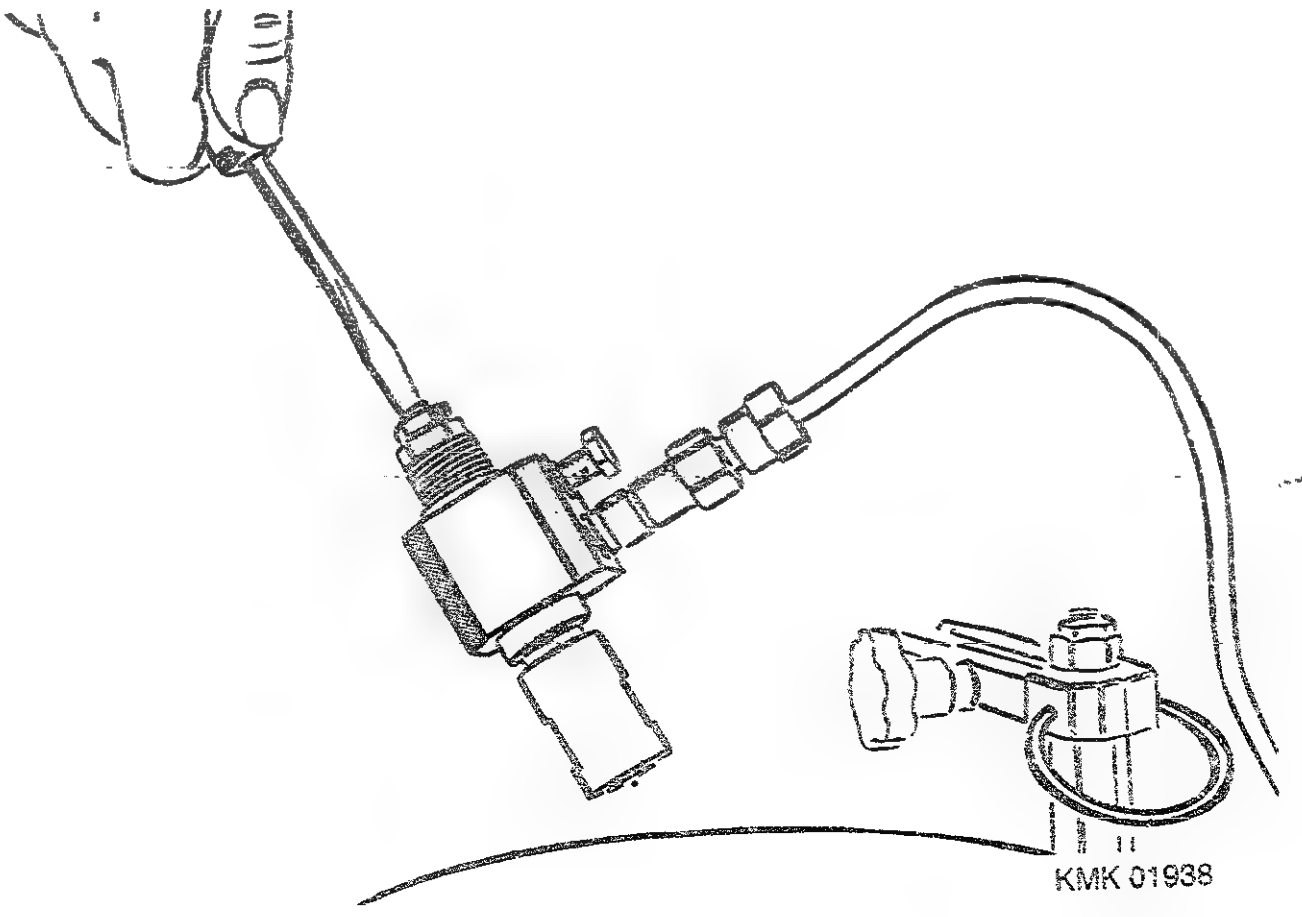
9.1.2 Adjusting opening pressure (KB(L)..S.., KB(F)..T.., KB(F)..U..)

Unscrew cap.

Loosen lock nut and turn adjusting screw until prescribed opening pressure is attained.
Screwing in the screw increases the opening pressure.

Once the required opening pressure has been obtained, tighten lock nut to prescribed torque and screw on cap.

Continue: G08/1 Fig.: G07/2



9.1.3 Tightening torques

Union	Nozzle holder type KB(L)..S.. Nm	KB..TA.. Nm	KBF..T.. Nm
Lock nut (for adjusting screw)	5...15	10...20	5...10
Cap nut (cap)	40...60	40...60	40...60

Continue: G08/2

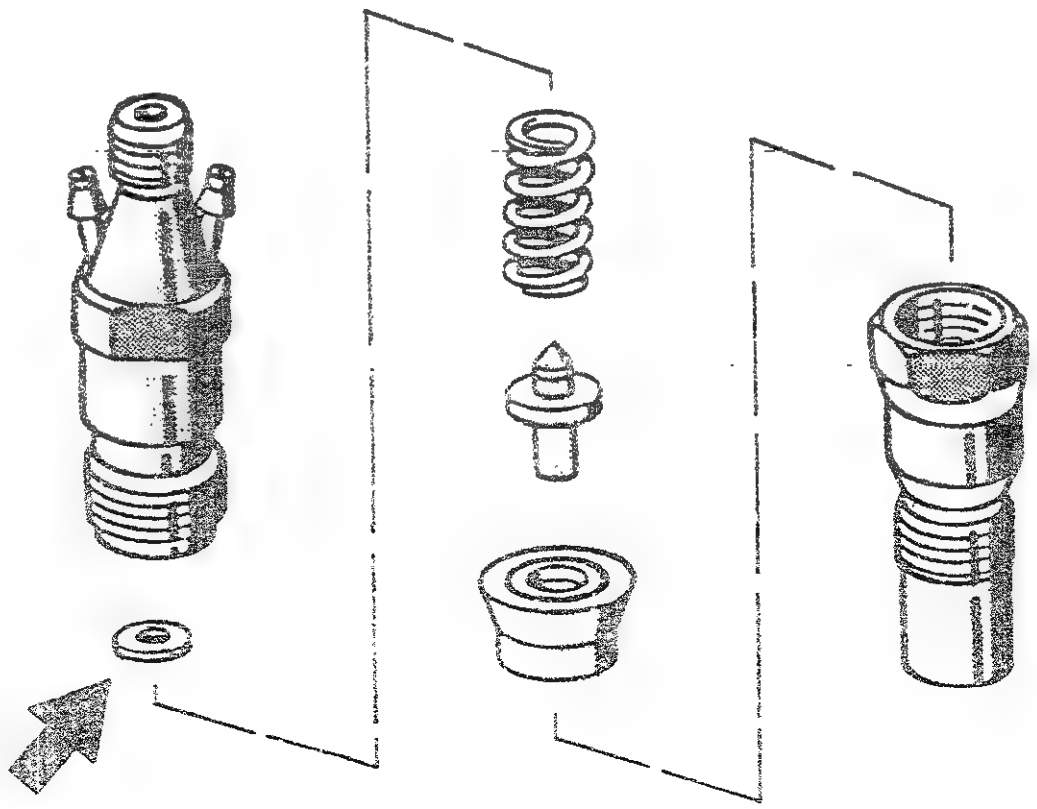
Tightening torques (continued)

Screw connection	Nozzle-holder assembly type KB..U.. Nm	KBF..U.. Nm
Lock nut (for adjusting screw)	30...40	10...20
Union nut (cap)	50...70	50...70

Continue: G09/1

9.1.4 Adjusting opening pressure
(KCA..S..), (KCE..S..)
Unscrew complete nozzle holder assembly from delivery tubing of nozzle tester and clamp in vice.
Use protective jaws!
Unscrew nozzle clamping nut.
Remove nozzle and set it down.
Remove all remaining parts of nozzle holder. The opening pressure is adjusted by selecting the required shim (refer to picture, arrow).
A thicker shim produces a higher opening pressure.

Continue: G10/1 Fig.: G09/2



KMK 01939

Checking pintle nozzles

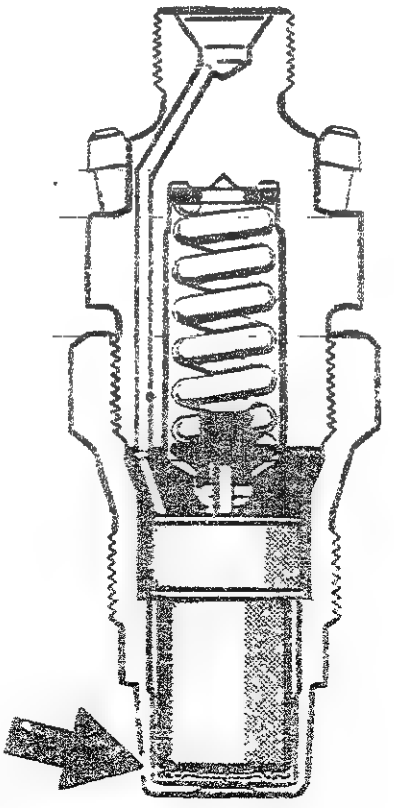
Then re-assemble nozzle holder assembly as prescribed and check on nozzle tester.

Continue: G11/1

Checking pintle nozzles

Once the prescribed opening pressure has been obtained, a new thermal-insulation washer is to be installed in the correct position in the nozzle tensioning nut in the case of nozzle-and-holder assemblies with integrated thermal insulation (see picture, arrow).

Continue: G12/1 Fig.: G11/2



KMK 01918

Checking pintle nozzles

9.1.5 Seat leak test

Shut-off valve at pressure gauge of nozzle tester remains open approx. half a turn. To make for reliable leakage assessment, dry bottom part of nozzle and nozzle holder (blow dry with air).
Slowly press down hand lever of nozzle tester until the pressure gauge indicates 20 bar below opening pressure previously read off.

Continue: G12/2

Checking pintle nozzles

The nozzle is leakproof if the time between two droplets is at least 10 seconds. Moisture at the mouth of the nozzle is permitted.

(If there are no droplets after 60 seconds, the seat leakage is likewise ok).

Continue: G13/1

Checking pintle nozzles

Leckage oil must not be allowed to falsify the test result.
If a droplet does, however, form, dismantle nozzle-and-holder cssembly again and clean parts of nozzle-holder assembly and nozzle to eliminate leak.
If the repeat test again reveals nozzle leakage, replace nozzle with a new one. Reworking of parts of the nozzle is not permitted.

Continue: G14/1

Checking pintle nozzles

9.1.6 Assembly leak test

Shut-off valve at pressure gauge of nozzle tester remains open approx. half a turn.
Press down hand lever of nozzle tester until pressure gauge indicates system pressure of 120 bar.
Release hand lever and measure time required for pressure to drop from 100 bar to 70 bar.
The permitted pressure drop-off time as a function of needle diameter and needle clearance is given in the test-specification microcard WP-430.

Continue: G14/2

Checking pintle nozzles

The time taken for the pressure to drop from 80 to 50 bar is to be measured in the case of nozzle-and-holder assemblies with an opening pressure of 125 bar or less.

If the pressure drops off more quickly than is permitted, there is a leak in the system as a whole (including nozzle tester).

Continue: G15/1

Checking pintle nozzles

9.1.7 Chatter test, assignment of spray pattern

General:
A distinction is to be made between new and used nozzles as regards assessment.

Perform chatter and spray test consecutively!
Switch off pressure gauge of nozzle tester by closing shut-off valve.
This is done to avoid damaging the pressure gauge.

Continue: G15/2

Checking pintle nozzles

New nozzles:

The chatter test makes it possible to audibly check the freedom of movement of the nozzle needle in the nozzle body.

If a nozzle does not chatter despite cleaning, it is to be replaced with a new one.
The shape of the spray is of no significance for the chatter test.
A spray pattern corresponding to the specification is generally only found with new nozzles.

Continue: G16/1

Checking pintle nozzles

Used nozzles:

The chatter behavior of the nozzle is impaired by wear in the seat area.
The nozzle must chatter audibly and/or produce a well-atomized spray when the lever is rapidly operated.
In the case of used nozzles, the spray pattern may deviate from the ideal shape with a new nozzle.

This does not however mean that impairment of the engine running behavior can always be concluded.

Continue: G16/2

Chatter test, assessment of spray pattern

The spray pattern of such spray nozzles can however be appreciably improved by means of suitable cleaning measures in an ultrasonic cleaning unit.

Continue: G17/1

Checking pintle nozzles

Pintle nozzles with no throttling effect
(New nozzles) DN..R.., DN..S.., DN..T..

Chatter test:
Such pintle nozzles feature readily audible chatter over the entire attainable lever-speed range.
Lowest test speed: 1 downward motion of hand lever per second.
There is no significance to small interim ranges with no chatter; the shape of the spray is likewise of no significance for the chatter test.

Continue: G17/2

Checking pintle nozzles

Spray pattern:
Even, well-atomized spray irrespective of test speed (pay attention to spray-dispersal angle).

Continue: G18/1

Checking pintle nozzles

Pintle nozzles with throttling effect including hole-type pintle nozzle, not including flat-type pintle nozzle and version for GMPT (GMC-Chevrolet)
DN 0 SD 248 - 0 434 250 105 or
DN 0 SD 253 - 0 434 250 111

DN..RD.., DN..S.., DN..TD..

Chatter test:
The special design features of this nozzle are such that the chatter is very quiet.

Continue: G18/2

Checking pintle nozzles

A chatter test is only possible in this case with between 1 and 2 downward movements of the hand lever per second.

The chatter stops if the test speed is increased.
The calibrating oil then emerges from the nozzle with a hissing noise.
The nozzle does not chatter loudly until the movement of the hand lever is rapid and abrupt (approx. 3...6 downward movements per second).

Continue: G19/1

Checking pintle nozzles

Spray pattern: (applies only to new nozzles)

It is only possible to assess the shape of the spray with rapid, abrupt downward motion of the hand lever. There must be a closed, well-atomized spray.

Continue: G19/2

Checking pintle nozzles

Pintle nozzles with throttling effect; version for GMPT (GMC/Chevrolet)
DN 0 SD 248 – 0 434 250 105 or
DN 0 SD 253 – 0 434 250 111
in the nozzle-and-holder assemblies
0 432 217 081, 0 432 217 092 and
0 432 217 104

Chatter test:

Perform chatter test as follows on account of the special design features:

Continue: G20/1

Checking pintle nozzles

Slowly press down hand lever of nozzle tester and establish whether chatter can be heard.

If no chatter can be heard, move hand lever more and more quickly until nozzle chatters.

If the nozzle cannot be made to chatter, first unscrew nozzle tensioning nut, thoroughly clean seat surface of nozzle thermal-insulation washer and nozzle tensioning nut, and re-assemble fitted with a new thermal-insulation washer.

Continue: G20/2

Checking pintle nozzles

If chatter is still not achieved, replace nozzle.
Spray test: (Applies only to new nozzles)
Rapidly and abruptly push down hand lever on nozzle tester.
There must be a closed, well-atomized fuel spray.

Continue: G21/1

Checking pintle nozzles

Pintle nozzle with spreading effect -
flat-pintle nozzle DN ..SD..

These nozzles feature a ground area on
the side of the pintle.
The surface thus produced results in an
oval spray.

Chatter test:

This nozzle chatters very quietly, on
account of the special design features.

Continue: G21/2

Checking pintle nozzles

A chatter test is only possible in
this case with between 1 and 2
downward movements of the hand lever
per second.
Increasing the test speed causes the
chatter to stop.

The calibrating oil then emerges from
the nozzle with a hissing noise.

This nozzle only whistles loudly when
the movement of the hand lever is
rapid and abrupt.

Checking pintle nozzles

Spray pattern: (Applies only to new nozzles)

Until the loud whistling tone starts, the spray may be streaky and non-atomized.

A split spray and the formation of streaks have no significance in this range.

To assess the shape of the spray, the hand lever is to be pressed down rapidly and abruptly.

The spray must then be thoroughly atomized.

Continue: G22/1

Checking pintle nozzles

The cross-section of the spray is oval in shape and is larger than the spray of a throttling pintle nozzle with no surface at the pintle.

Continue: G22/1

Checking pintle nozzles

Pintle nozzle with throttling effect -
Pintaux nozzles DN. SD. , DN4..SD

The bottom of these nozzles is specially shaped and there is an additional hole through which the pre-spray emerges.

Chatter test:

The chatter with this nozzle is very quiet on account of the special design fectures. A chatter test is only possible in this case with between 1 and 2 downward movements of the hand lever per second.

Continue: G23/2

Checking pintle nozzles

Increasing the test speed causes the chatter to stop.

The calibrating oil then emerges from the nozzle with a hissing noise.

This nozzle only whistles loudly when the movement of the hand lever is rapid and abrupt.

Spray pattern: (Applies only to new nozzles)

Continue: G24/1

Obtaining airtile results:

At the test speed, the majority of the amount delivered must be thoroughly atomized and emerge through the pre-spray hole on the side without any pronounced streaking.

Assessment of the main spray is only possible with rapid movement of the hand lever (approx. 4 ... 6 downward movements per second)

There must be a closed, well-atomized spray.

Continue: G25/1

6.1 Checking pole-type nozzles and pole-type nozzles with seat

Test criteria:

* Opening pressure
* Seat leakage
* Assembly leakage
* Chatter behavior
* Spray pattern

Use is to be made of pure calibrating oil as per ISO 4113 for test purposes. If use is made of diesel fuel, the test is not in line with the Standard. Check nozzles with corresponding nozzle holders.

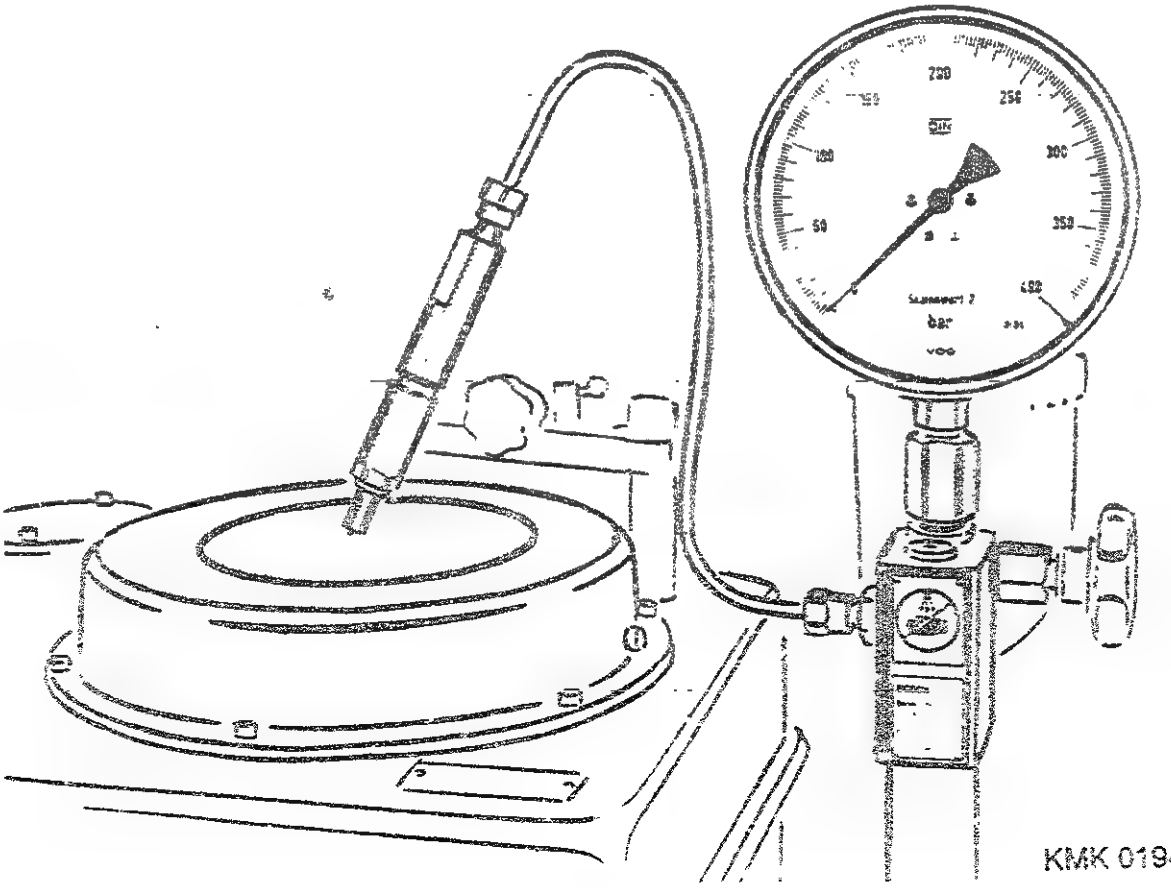
Continue: G26/1

Checking hole-type nozzles and hole-type nozzles with seat

Connect up nozzle holder assembly to nozzle tester 0 684 200 704 (EPS 100) with appropriate test pressure line.

To ensure that the nozzle is not subjected to torsion, force down hand lever of nozzle tester several times with pressure gauge switched off.

Continue: G27/1 Fig.: G26/



Checking hole-type nozzles and pintle nozzles

Attention is to be paid to the following safety precautions when working on the nozzle tester:

Keep hands away from calibrating-oil jet!

The calibrating-oil jet from a nozzle can penetrate deep into the tissue of the human body.

The high pressure and the ingress of calibrating oil can destroy the tissue structure and possibly result in blood poisoning.

Continue: G28/1

Checking hole-type nozzles and hole-type nozzles with seat

3.2.1 Checking opening pressure

Open shut-off valve at pressure gauge approx. half a turn.
Slowly press down hand lever of nozzle tester. This causes the pressure indicated on the pressure gauge to increase.
Note pressure at which the pointer of the pressure gauge comes to a halt (no nozzle chatter) or the pressure at which there is a sudden drop in pressure (nozzle chatter).
The maximum pressure attained is the opening pressure.

Continue: G28/2

Checking hole-type and valve covered orifice nozzles

In some cases the envisaged opening pressure for the nozzle-and-holder assembly is stamped on the nozzle-holder body.

If this is not the case, the value is to be determined from the appropriate documentation of the engine manufacturer or from the microcards via Equipment (AK).

Generally speaking the adjustment tolerance is ± 8 bar.

Continue: H01/1

Checking hole-type nozzles and
hole-type nozzles with seat

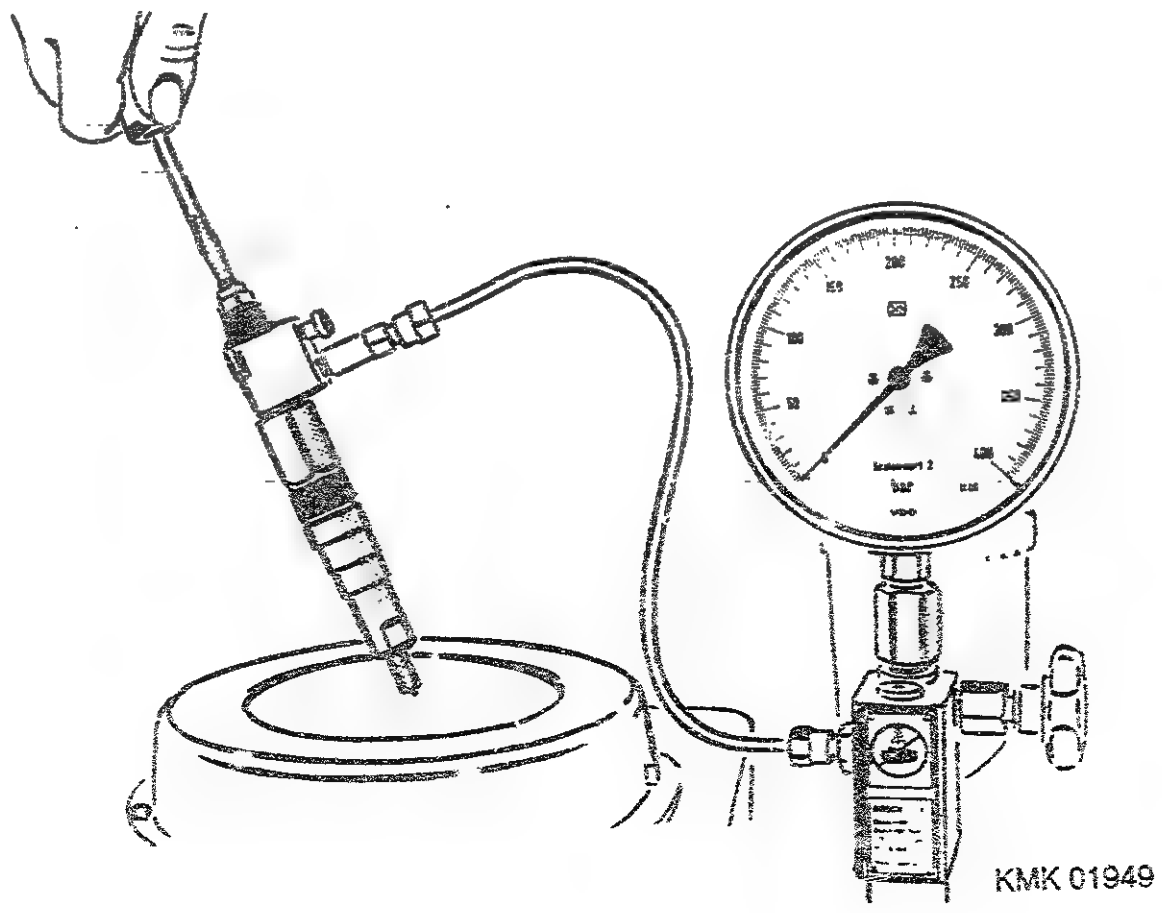
9.2.2 Adjusting opening pressure
(KS(L)..S..), (KB..TA..), (KBF..T..)

Unscrew cap.
Loosen lock nut and turn adjusting
screw until prescribed opening
pressure is attained.

Screwing in the screw increases the
opening pressure.

Once the required opening pressure has
been obtained, tighten lock nut to
prescribed torque and screw on cap.

Continue: H02/1 Fig.: H01/2



Checking hole-type nozzles and
hole-type nozzles with seat

9.2.3 Tightening torques

Screw connection	Nozzle holder type KB(L)..S.. Nm	KB..TA.. Nm	KBF..T.. Nm
Lock nut (for adjusting screw)	5...15	10...20	5...10
Cap nut (cap)	40...60	40...60	40...60

Continue: H02/2

Checking hole-type nozzles and
seat-hole nozzles

Tightening torques (continued)

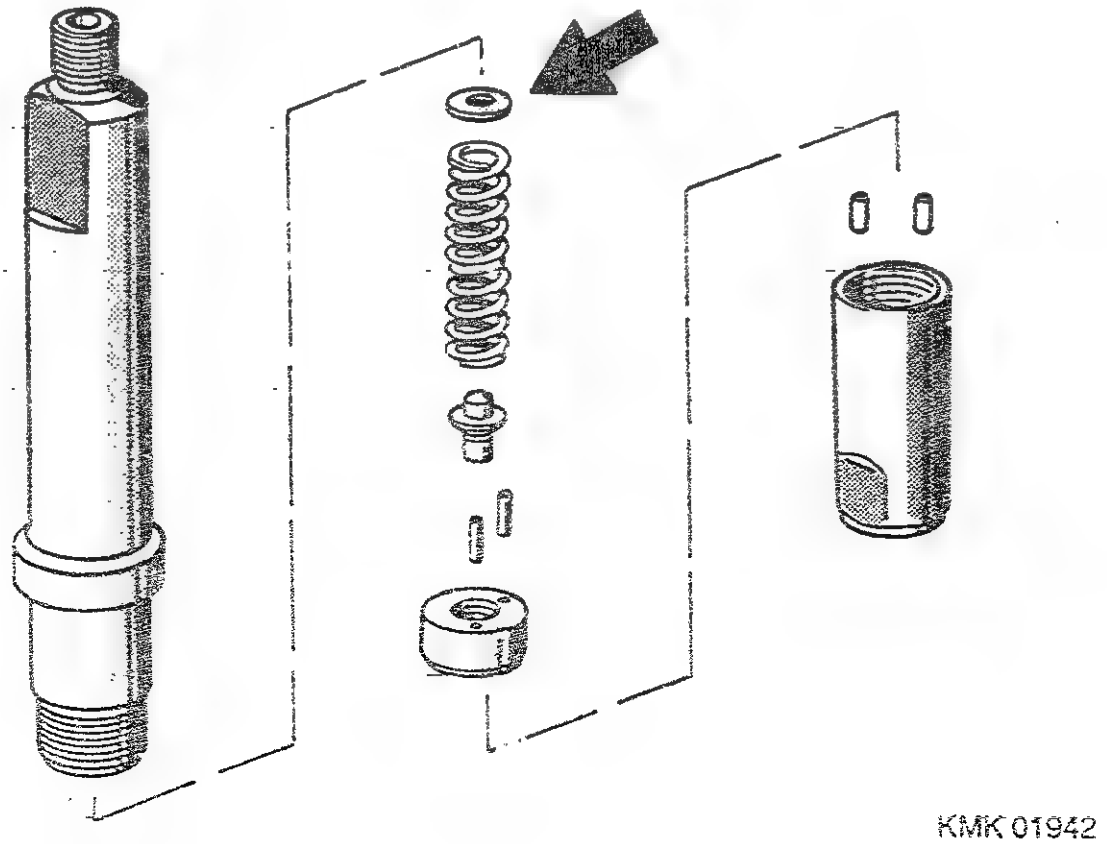
Screw connection	Nozzle-holder assembly type KB..U.. Nm	KBF..U.. Nm
Lock nut (for adjusting screw)	30...40	10...20
Union nut (cap)	50...70	50...70

Continue: H03/1

Checking hole-type nozzles and hole-type nozzles with seat

9.2.4 Adjusting opening pressure (KDAL(Z)..), KDEL(Z)..)
Unscrew complete nozzle holder assembly from delivery tubing of nozzle tester and clamp in vice.
Use protective jaws!
Unscrew nozzle clamping nut.
Remove nozzle and set it down.
Remove all other parts of nozzle holder. The opening pressure is adjusted by selecting the required shim (refer to picture, arrow).
A thicker shim produces a higher opening pressure.

Continue: H04/1 Fig.: H03/2



KMK 01942

Checking hole-type nozzles and seat-hole nozzles

Then re-assemble nozzle-and-holder assembly as prescribed and check on nozzle tester.

Continue: H04/2

Checking hole-type nozzles and seat-hole nozzles

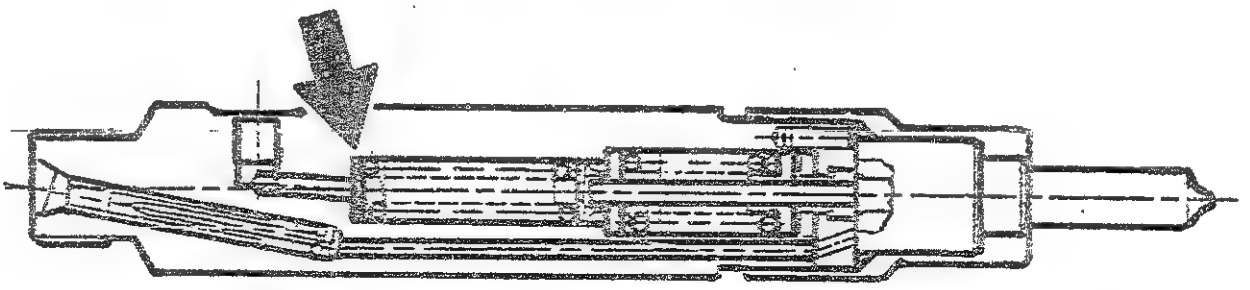
Adjusting opening pressure (KBEL..P..), (KDEL..P..) (dual-spring holder)
Unscrew complete nozzle-and-holder assembly from pressure line of nozzle tester and clamp in position in vice. Make use of protective jaws!
Unscrew nozzle tensioning nut.
Remove and set down nozzle.
Remove 2nd-stage parts and store complete on mandrel. Remove first-stage parts.

Continue: H05/1

Checking hole-type nozzles and seat-hole nozzles

The opening pressure is adjusted by selecting the required shim (see picture, arrow). A thicker shim produces a higher opening pressure.

Continue: H06/1 Fig.: H05/2



KMK 01943

Checking hole-type nozzles and
hole-type nozzles with seat

9.2.5 Seat leak test

Shut-off valve at pressure gauge of nozzle tester remains open approx. half a turn.
So as to ensure reliable assessment of leakage, dry bottom part of nozzle and nozzle holder (blow dry with air).
Slowly press down hand lever of nozzle tester until pressure gauge indicates 20 bar below opening pressure previously read off.

Continue: H06/2

Checking hole-type nozzles and
seat-hole nozzles

The nozzle is leakproof if the time between two droplets is at least 10 seconds. Moisture at the mouth of the nozzle is permitted.

(If there are no droplets after 60 seconds, the seat leakage is likewise ok).

Continue: H07/1

Checking hole-type nozzles and
seat-hole nozzles

If a droplet does drip off, dismantle nozzle-and-holder assembly again and clean parts of nozzle-holder assembly and nozzle to eliminate leak.

If the repeat test again reveals nozzle leakage, the nozzle is to be replaced with a new one.

Reworking of parts of the nozzle is not permitted.

Continue: H07/2

Checking hole-type nozzles and
hole-type nozzles with seat

9.2.6 Assembly leak test

Shut-off valve at pressure gauge of nozzle tester remains open approx. half a turn.
Press down hand lever of nozzle tester until pressure gauge indicates a system pressure of 120 bar.
Release hand lever and measure time required for pressure to drop from 100 bar to 70 bar.
The permissible pressure drop-off time as a function of needle diameter and needle clearance is indicated in the test-specification microcard WP-430.

Continue: H08/1

Checking hole-type nozzles and
hole-type nozzles with seat

9.2.7 Chatter test, assignment of
spray pattern

General:

A distinction is to be made between
new and used nozzles as regards
assessment.
Perform chatter and spray test
consecutively!
Switch off pressure gauge of nozzle
tester by closing shut-off valve.
This is done so as not to damage the
pressure gauge.

Continue: H08/2

Checking hole-type nozzles and
seat-hole nozzles

The time required for drop in pressure
from 80 to 50 bar is to be measured
in the case of nozzle-and-holder
assemblies with an opening pressure
of 125 bar or less.

If the pressure drops off more quickly
than is permitted, there is a leak in
the system as a whole (including
nozzle tester).

Continue: H09/1

Checking hole-type nozzles and seat-hole nozzles

New nozzles:

The chatter test makes it possible to audibly check the freedom of movement of the nozzle needle in the nozzle body.
The chatter of new nozzles is a function of the nozzle dimensions: Seat, guide and blind hole/grinding diameter at end of needle for DLL(A).. nozzles; seat guide and hole-circle diameter with DSLA nozzles.
This results in the formation of chatter characteristic groups which reflect the chatter behavior of the nozzles.

Continue: H09/2

Checking hole-type nozzles and seat-hole nozzles

If a nozzle does not chatter despite cleaning, it is to be replaced with a new one.
The shape of the spray is of no significance for the chatter test.

A spray pattern corresponding to the specification is generally only found with new nozzles.

It is not possible to assess the spray pattern of dual-spring assemblies with the nozzle tester.

Continue: H10/1

Checking hole-type nozzles and seat-hole nozzles

Used nozzles:

Wear in the seat area impairs the chatter behavior of the nozzle. For this reason, the chatter characteristic groups are not to be used here.
If the lever is operated quickly, the nozzle must be heard to chatter (possibly with loud whistling tone) and the spray must be thoroughly atomized.

Continue: H10/2

Checking hole-type nozzles and seat-hole nozzles

In individual cases, a hole-type nozzle is still serviceable if it chatters audibly (possibly loud whistling tone) or if it provides a well-atomized spray.

Continue: H11/1

Checking hole-type nozzles and seat-hole nozzles

The spray pattern with used nozzles may deviate from the ideal shape of a new nozzle.

This does not however always mean that poor engine running behavior can be concluded.

The spray pattern of such nozzles can, however, be noticeably improved by way of suitable cleaning measures.

Continue: H11/2

Checking hole-type nozzles and seat-hole nozzles

The microcard WP-430 gives an indication of the chatter characteristic group according to which the corresponding nozzle is to be checked.

The diagrams below are intended to outline the movements of the nozzle needles as they chatter as a function of the speed of movement of the nozzle-tester lever in the individual characteristic groups.

Continue: H12/1

Checking hole-type nozzles and
semi-hole nozzles

CHATTER CHARACTERISTIC GROUP I

Chatter:
Good chatter in entire lever-speed
range.
Lowest test speed: One downward
movement per second.
Spray pattern:
Given low test speed, dispersed spray
with coarse atomization. The spray
becomes full and finaly atomized with
increasing lever speed.

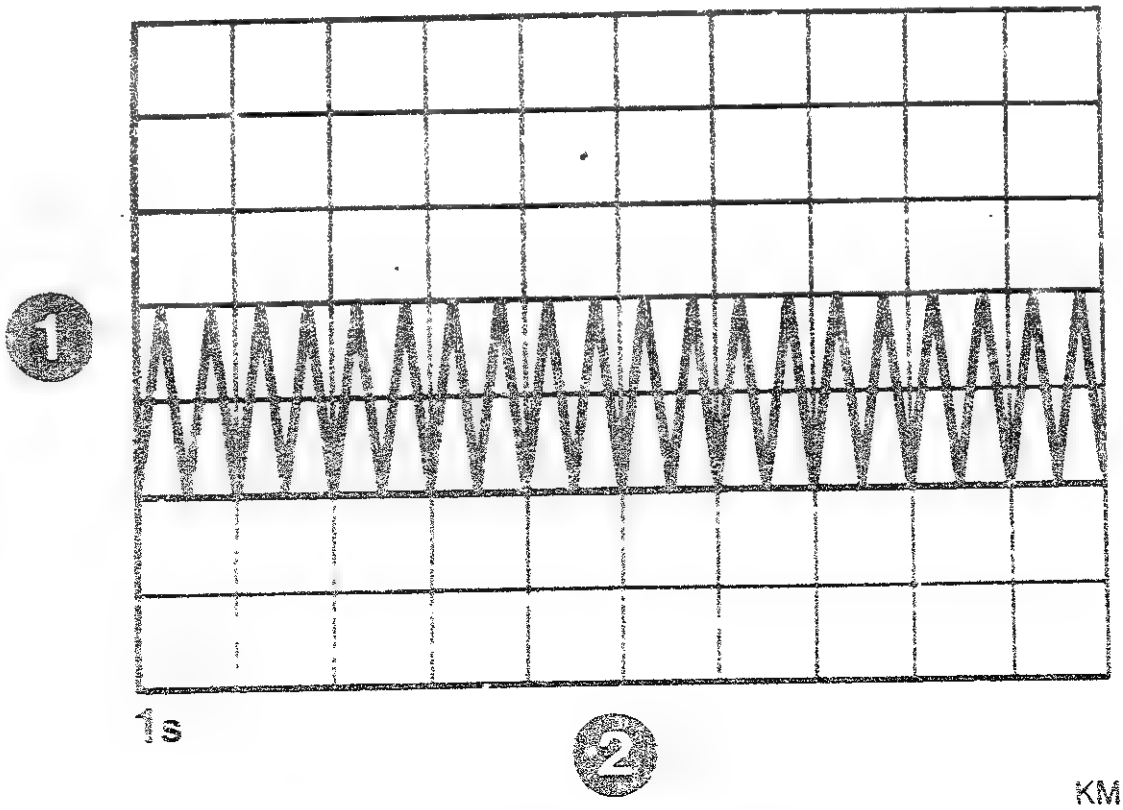
Continue: H13/1

Cracking hole-type nozzles and seat-hole nozzles

Important: With some DLL(A).. nozzle types the calibrating oil emerging may be unevenly distributed over the holes. This always applies to DSLA nozzles.

1 = Needle stroke
2 = Time for 1 downward movement of hand lever (increasing test speed)

Continue: H14/1 Fig.: H13/2



KMK 01944

Checking hole-type nozzles and
seat-hole nozzles

CHATTER CHARACTERISTIC GROUP II

Chatter behavior: Good chatter at high and low lever speed. There may be small interim ranges with no chatter.
Spray pattern:
Given low test speed, dispersed spray with coarse atomization. Non-atomized cord-like spray in no-chatter range. The spray becomes full and finaly atomized with increasing lever speed.

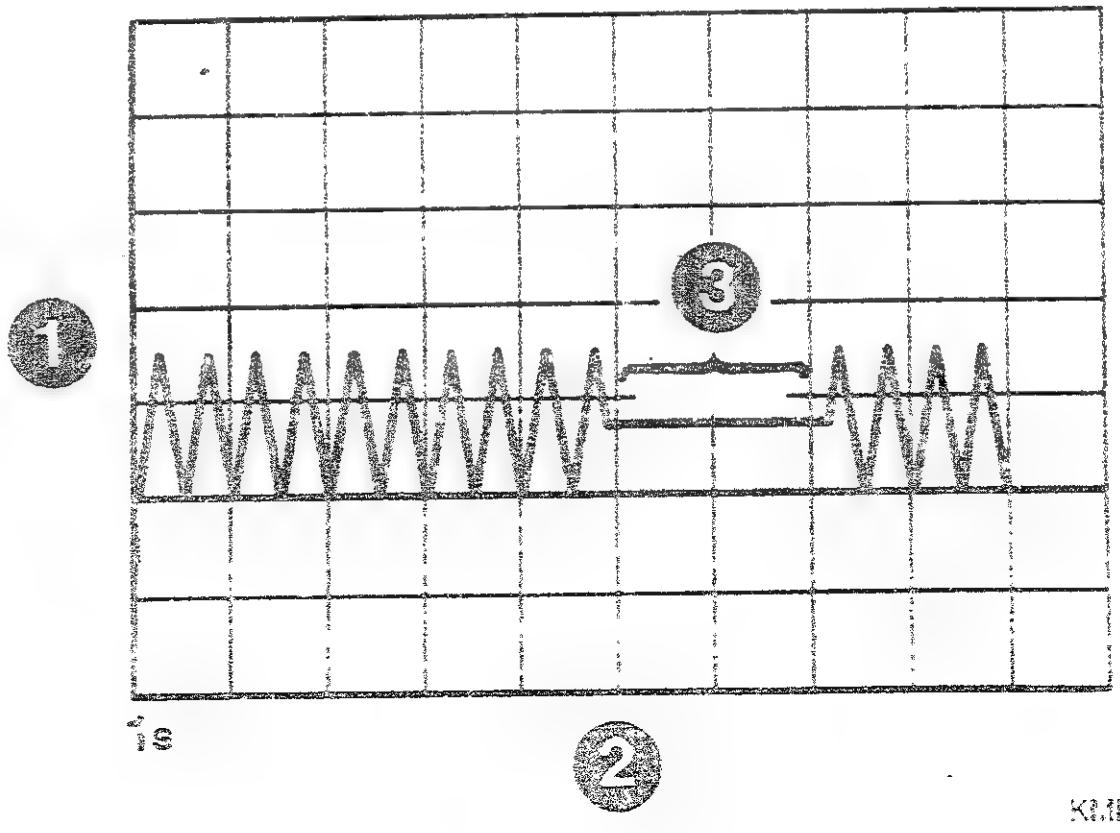
Continue: H15/1

Checking hole-type nozzles and seat-hole nozzles

Important: With some DL..(A).. nozzle types the calibrating oil emerging may be unevenly distributed over the holes. This always applies to DSLA nozzles.

1 = Needle stroke
2 = Time for 1 downward movement of hand lever (increasing test speed)
3 = No chatter

Continue: H16/1 Fig.: H15/2



KMK 01945

Checking hole-type nozzles are
seat-hole nozzles

CHATTER CHARACTERISTIC GROUP III,

Chatter behavior:
Chatter only with slow and fast lever
operation; there is a broad no-chatter
area between the two.
Spray pattern:
Non-atomized cord-like spray up to
high test speed.
The spray then becomes full and finely
atomized.

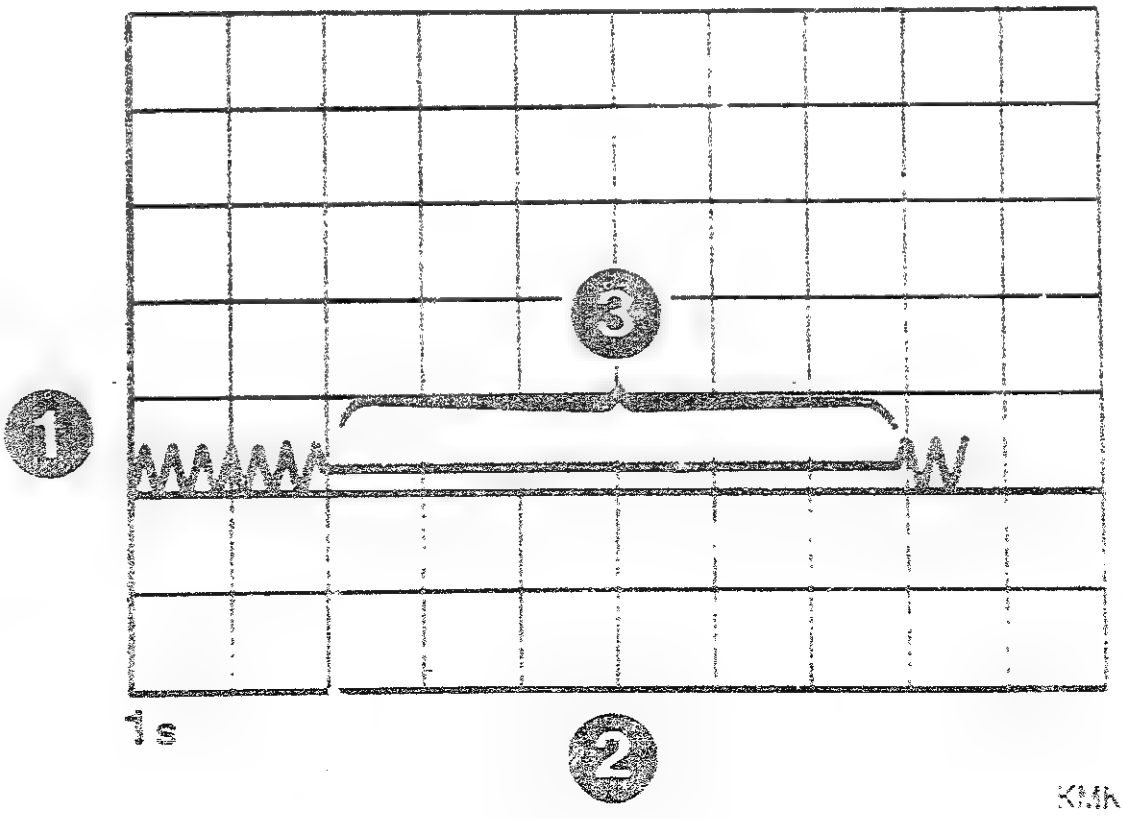
Continue: H17/1

Checking hole-type nozzles and
seat-hole nozzles

Important: With some DLL(A).. nozzle types the calibrating oil emerging may be unevenly distributed over the holes. This always applies to DSLA nozzles.

1 = Needle stroke
2 = Time for 1 downward movement of hand lever (increasing test speed)
3 = Does not chatter and drips

Continue: J01/1 Fig.: H17/2



KMK 01946

10. CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

* Opening pressure
* Seat leakage
* Assembly leakage

Exclusive use is to be made for checking of pure calibrating oil as per ISO 4113. The calibrating oil is only to be used once. The test equipment consists of the nozzle tester 0 684 200 704 – EPS 100 – corresponding to ISO 8984 and the test-pressure line 1 680 750 008. The calibrating-oil temperature is 18...20°C.

Continue: J01/2

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

10.1 Preparation

Disassemble spray damper. To do so, clamp flats of spray cap in vice (use protective jaws). Loosen nozzle-holder assembly with open-ended wrench at flats and remove from spray cap.

Continue: J02/1

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

Use appropriate test-pressure line to connect up nozzle-and-holder assembly to nozzle tester 0 684 200 704 (EPS 100).

To ensure that there is no nozzle stress, force down the hand lever of the nozzle tester several times with pressure gauge disconnected (approx. 4...6 downward movements per second).

Continue: I03/1

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

Attention is to be paid to the following safety precautions when working on the nozzle tester:

Keep hands away from calibrating-oil jet!

The calibrating-oil jet from a nozzle can penetrate deep into the tissue of the human body.

The high pressure and the ingress of calibrating oil can destroy the tissue structure and possibly result in blood poisoning.

Continue: J04/1

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

10.2 CHECKING

10.2.1 Checking opening pressure

Open shutoff valve on pressure gauge approximately 1/2 turn.
Slowly press down hand lever of nozzle tester. This causes the pressure indicated on the gauge to increase.
Observe the pressure at which the pointer of the pressure gauge comes to a halt (no nozzle chatter) or when the pressure suddenly drops off (nozzle chatters).

Continue: J04/2

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

The maximum pressure attained is the opening pressure envisaged for the nozzle-and-holder assembly and is marked in the nozzle-holder body.
The tolerance is + 3 bar.

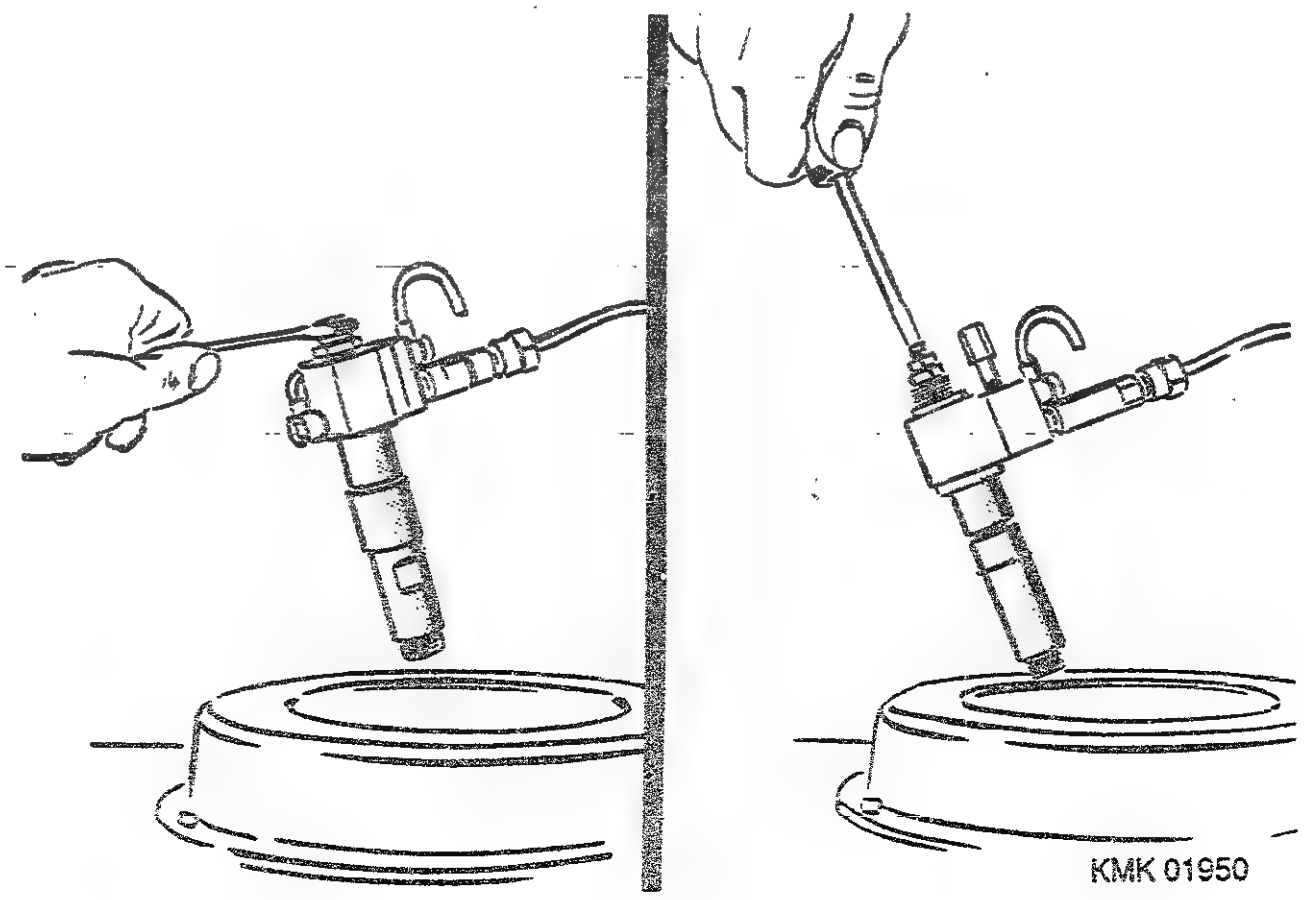
Continue: J05/1

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

10.2.2 Adjusting opening pressure

Unscrew cap.
Loosen lock nut and use a screwdriver or open-ended wrench to turn adjusting screw until the prescribed opening pressure is reached. Turning in the screw produces a higher opening pressure.
Once the required opening pressure has been reached, tighten lock nut to prescribed tightening torque and screw on cap.

Continue: J06/1 Fig.: J05/2



CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

10.2.3 Tightening torques

Screw connection	Tightening torque Nm
Lock nut (for adjusting screw)	5...10

Continue: J06/2

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

Tightening torques (continued)

Union nut (cap)	40...60

Continue: J07/1

CHECKING OF TEST NOZZLE HOLDER ASSEMBLIES:

10.2.4 Seat leak test

Test nozzle holder assembly with pintle nozzle and no spacer bushing

Shut-off valv at pressure gauge of nozzle tester remains open approx. half a turn.
To make for reliable leakage assessment, dry bottom part of nozzle and nozzle holder (blow dry with air).
Slowly press down hand lever of nozzle tester until pressure gauge indicates 20 bar below opening pressure previously read off.

Continue: J07/2

CHECKING OF TEST NOZZLE HOLDER ASSEMBLIES:

The nozzle is not leaking if the time between two droplets dribbling off is at least 10 seconds.
Moisture at the mouth of the nozzle is permitted.
Any leakage fuel which emerges must not be permitted to bias the test result.
If, however, a droplet dribbles off, disassemble nozzle holder assembly again, clean component parts of nozzle holder and nozzle and thus eliminate leakage.

Continue: J08/1

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

If the repeat test again reveals nozzle leakage, it is to be replaced with a new one. Reworking parts of the nozzle is not permitted.

Continue: J08/2

CHECKING OF TEST NOZZLE HOLDER ASSEMBLIES:

Test nozzle holder assembly with perforated plate or pintle nozzle with spacer bushing

Shut-off valve at pressure gauge of nozzle tester remains open approximately a quarter of a turn. Spray calibrating oil at slow lever speed to moisten inside of spacer bushing with calibrating oil. Slowly press down hand lever of nozzle tester until pressure gauge indicates 20 bar below opening pressure previously read off.

Continue: J09/1

CHECKING OF TEST NOZZLE HOLDER ASSEMBLIES:

The nozzle is not leaking if the time between two droplets dribbling off is at least 10 seconds. (Moisture at bottom of spacer bushing is permitted). Any leakage fuel which emerges must not be permitted to bias the test result.
If, however, a droplet dribbles off, disassemble nozzle holder assembly again, clean component parts of nozzle holder and nozzle and thus eliminate leakage.

Continue: J09/2

CHECKING OF CALIBRATING NOZZLE-HOLDER ASSEMBLIES:

If the repeat test again reveals nozzle leakage, it is to be replaced with a new one. Reworking parts of the nozzle is not permitted.

Continue: J10/1

CHECKING OF TEST NOZZLE HOLDER ASSEMBLIES:

10.2.5 Assembly leak test

Shut-off valve at pressure gauge of nozzle tester remains open approx. half a turn.
Press down hand lever of nozzle tester until pressure gauge indicates a system pressure of 120 bar.

Release hand lever and measure time required for pressure to drop from 100 bar to 70 bar.
The permitted pressure drop-off time is a function of the needle diameter.

Continue: J10/2

CHECKING OF TEST NOZZLE HOLDER ASSEMBLIES:

The pressure drop-off time is at least 10 seconds for nozzles with a needle diameter of 4 mm and at least 8 seconds for needles with a diameter of 6 mm.
The nozzle 1 688 901 987 contained in the test nozzle holder assemblies 1 688 901 114...117 features a needle with a diameter of 4 mm. All other test nozzles contain needles with 6 mm diameter.

Continue: N24/1

INDEX

Continue: N24/2

INDEX

Continue: N25/1

INDEX

Continue: N25/2

INDEX

Continue. N26/1

TABLE OF CONTENTS

Continue: N26/2

TABLE OF CONTENTS

Continue: N27/1

TABLE OF CONTENTS

Continue: N28/1

EDITORIAL NOTE

Published by:
After-Sales Service Department for
Training and
Technology (KH/VSK).
Time of going to press: 12.1992.
Please direct questions and comments
concerning the contents to our
authorized representative in your
country.

Continue: 028/2

EDITORIAL NOTE

Microfilmed in the Federal Republic of
Germany.

Mikroverfilmt in der Bundesrepublik
Deutschland.

Continue: 028/1